Chapter 23

Bottom-up Initiatives and Participatory Approaches for Outlooks

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Executive summary

The challenge of sustainable development offers the opportunity for more effective integration of global and local scenario approaches in environmental assessments and outlooks to support decision-making for all 17 Sustainable Development Goals (SDGs) at all levels (i.e. local, national, regional and global) (*established, but incomplete*). A bottom-up perspective on the future, which is based on local scenarios and practices offers potential benefits for exploring alternative futures that are grounded in local realities and start with existing practical action that can be appropriately scaled. Linking top-down and bottom-up approaches to multilevel scenario development provides an opportunity for global processes to inform local actions and for taking account of local actions in global agreements. Co-developing approaches with diverse stakeholders will help to overcome the current limitations in scaling innovations up, out and deep, and in transferring valuable lessons and results from local to both regional and global levels, and vice versa {23.1}.

The bottom-up approach engages a broad range of scientific and action-oriented knowledge, perspectives and opinions about a desirable world in the future and the ways to get there, including pathways to achieve long-term sustainability goals (e.g. the SDGs) (*established, but incomplete*). Since there is no single answer to achieving sustainability, having multiple perspectives is essential for defining different desirable futures. Through a combination of crowdsourcing platforms, participatory workshops in different regions of the world, analyses of existing sustainability solutions and an assessment of regional outlooks, novel methods for linking the generic results of global models with complementary information and insight from the local level can be undertaken. The outcome from the implementation of such an innovative framework provides useful and relevant information and knowledge for policymakers and practitioners to make more informed decisions about how to achieve a sustainable future {23.4, 23.6}.

A groundswell of bottom-up efforts to realize the SDGs and other multilateral environmental agreements is currently under way, as are efforts to support and facilitate collaboration among them *(established, but incomplete*). Reviewing platforms of bottom-up initiatives provides a preliminary understanding of the breadth and depth of ideas, actions and programmes that seek to help achieve sustainable development objectives. The clear majority of the platforms have a global level of coverage, drawing on examples and encouraging connections from all over the world. Most of the platforms facilitate knowledge-sharing and the identification of solutions in two ways. First, this is through the collection of examples, solutions and best practices (e.g. United Nations Framework Convention on Climate Change [UNFCCC] Momentum for Change Lighthouse Initiative, PANORAMA Solutions for a Healthy Planet; WOCAT; see Annex 23-1), and, second, by creating forums for sharing technical or regional tools and know-how for on-the-ground activities (e.g. Biofin Knowledge Platform, ClimateTechWiki). Other platforms use contests or crowdsourcing to generate and synthesize solutions to challenging questions (e.g. VertMTL, MIT Climate CoLab). These platforms highlight the importance of involving a wider variety of people to complement government policies and initiatives {23.9}.

The GEO Regional Assessments highlight important global environmental pressures in the future, but also emphasize regional priorities and solutions that are critical in decision-making processes (*well established*). GEO-Africa focused on so-called leapfrogging development and emphasized low-carbon, resilient infrastructure for meeting food, energy, water and housing needs while maintaining the continent's ecological assets. Asia and the Pacific had different regional priorities, including disaster-risk reduction as an important consideration, and smart cities were outlined as potential solutions, given population and urbanization trends. Latin America and the Caribbean focused on decoupling economic growth from the use of natural resources through sustainable management and ecosystem-based resilience. Europe recognized the need for lifestyle and consumption changes to reach sustainability goals. North America did provide a scenario analysis but emphasized technological innovation and the data revolution as mechanisms for achieving sustainable development. West Asia emphasized peace and security and the importance of integrated resource management to manage limited natural resources such as water. While climate change is a driver considered across all the regions, adaptation and mitigation pathways are suggested within framings {23.10}.

Data and knowledge gaps exist in the bottom-up analysis, emphasizing a need to broaden out the participatory approaches across scales *(unresolved)*. The gaps associated with these bottom-up processes can be grouped into four broad categories as follows. (1) Gaps to do with interconnections across regions: connections and inter-dependencies across regions were not highlighted in most Regional Assessments. (2) Gaps to do with cross cutting themes such as gender, equity and inequality are absent in all but the assessments for Africa and Latin America and the Caribbean. These are more likely to be addressed through a bottom-up approach. (3) Gaps to do with specific resources: interventions for freshwater and oceans are the least addressed in bottom-up initiatives. The Climate CoLab proposals and initiatives focused on freshwater interventions mostly on WASH (water, sanitation and hygiene) and no bottom-up initiatives addressed desalination or ocean regulation. (4) Gaps to do with human well-being: these include solutions predominantly focused on poverty alleviation, while child and maternal health care was addressed by only one Climate CoLab proposal. This highlights an important area for government interventions to target these specific areas {23.9}.

Participatory approaches to identify and assess transformative solutions and envision pathways towards greater sustainability can provide decision makers with a useful landscape of initiatives and concrete synergistic solutions *(established, but incomplete)*. By engaging with stakeholders through global workshops and Climate CoLab, GEO-6 could collect many diverse solutions and visions that can complement, and potentially be fed into, quantitative information in integrated assessment models. These participatory approaches can help to shift the focus of outlooks work from the 'what' to the 'how'. For example, there was a strong emphasis on food systems as critical intervention points to move towards a healthy planet, healthy people. Chapter 22 identifies yield-improvement targets and general

solutions such as diet change and reduced pesticide use. These are complemented by initiatives from the workshops and the Climate CoLab that elaborate on specific campaigns taking place right now that provide examples of how to promote diet change and innovations for more high-yield sustainable farming, e.g. Apps to promote sharing economies to reduce food waste in cities; urban agriculture; aquaculture; indigenous and local knowledge exchanges {23.12}.

Transformations to sustainability require both social and technical innovations as well as an enabling policy environment in which to scale these ideas and solutions appropriately *(established, but incomplete)*. Sustainability transformations refer to the systemic changes that are needed to move from a business-as-usual trajectory to a more sustainable future. Transformation is often broken down into multiple phases with temporal periods related to a problematic status quo, a preparation phase in which innovations begin to develop, a navigation/acceleration phase in which innovations grow and become part of the new system, and an institutionalization phase in which a more desirable system is made sustainable in the longer term. Each of these phases requires strongly enabling governance conditions for transformations to occur successfully. These enabling conditions can best be broken into:

- Supporting conditions for the appropriate scaling of innovations (establishing and supporting markets for innovations; supporting innovation experimentation and learning; financial resource mobilization; human resource mobilization)
- Disrupting conditions for the weakening of existing, problematic structures (control policies; rules reform; reduction in existing regime support; changes in networks and key actors and their relationships) {23.12}.

The combined analysis of bottom-up and regional solutions for achieving a healthy planet, healthy people highlight the need to consider a full range of actors, to enable distributive justice and to ensure fair perceptions about where action should be expected to take place *(established, but incomplete)*. Many solutions offer the opportunity for developing countries to leapfrog onto more sustainable and equitable development trajectories. The use of information and communications technology (ICT) plays a major role as a tool for driving change. Furthermore, the roles of different societal actors are made explicit in bottom-up pathways. For instance, there is an important role for city-level government actors, in many of the initiatives assessed in this report, as well as for global networks, like sustainable cities or energy cooperatives. Based on the experiences of GEO-6, participatory work in the future can be enhanced by engaging globally with stakeholders from a greater diversity of backgrounds, focusing on policy-relevant data collection, such as actor roles and barriers to change, and further refining processes of transformation and the equity implications of proposed interventions {23.13}.

23.1 Introduction

The rapid pace and scale of societal and environmental changes in the Anthropocene, where human activity dominates most of the Earth's processes (Crutzen 2006; Leach *et al.* 2013; Steffen *et al.* 2015) are changing how assessments are carried out. Global environmental assessments (including GEO-6) are moving the focus from current trends (e.g. what is the current state of biodiversity?) towards the required transformations for a more sustainable future, and the means to get there (e.g. what interventions are needed to keep global warming below 1.5°C?) (Kowarsch *et al.* 2017; Minx *et al.* 2017). Decision-makers, scholars and practitioners are demanding a deeper and more explicit focus on response options and policy analysis (Jabbour and Flachsland 2017). This shift in intention and direction is especially relevant in the context of the Sustainable Development Goals (SDGs), where nations have set the ambition to achieve a broad range of globally accepted and integrated social, economic and environmental targets for 2030. However, medium- to long-term decision-making is complicated by the fact that the future is uncertain, and it is often not obvious how existing policies and practices can be transformed to achieve desired future outcomes (Miller 2013; Miller, Poli and Rossel 2013; Bennett *et al.* 2016).

Global environmental assessments distil, synthesize and interpret existing information in ways that are relevant to decision makers and can help governments to achieve consensus when negotiating complex international accords and agreements (e.g. the Paris Climate Agreement and the United Nations 2030 Agenda for Sustainable Development) (Jabbour and Flachsland 2017). However, while global environmental assessments often rely on global-scale quantitative scenarios to assess potential futures and to navigate uncertainty (van Vuuren *et al.* 2012), they struggle to integrate dynamics that can bridge local, regional and global scales (Bennett *et al.* 2003). Furthermore, integrated assessment models like those employed in Chapter 22 to develop quantitative global scenarios, struggle to simulate decisions that engage multiple jurisdictional levels, as well as diverse actors, and therefore cannot capture the impact of trends emerging from subglobal scales. As a result, while such scenarios present archetypal, globally unified futures, it is not always clear to decision makers how national policies can use these in ways that are geared for local decisions and action (Biggs *et al.* 2015; Pereira *et al.* 2018a).

The successful implementation of transformative pathways requires an understanding of:

i. how transformational changes occur at local, national, regional and global levels;
ii. which actors and what disruptive technologies (i.e. those that replace incumbent technologies creating new markets) drive such changes; and
iii. what the consequences of transformative action might be in terms of cross-scale connections (Cash *et al.* 2006; Feola 2015; Patterson *et al.* 2017).

This is where the combination of top-down scenarios and bottom-up analyses is crucial.

This chapter assesses participatory processes and local practices seeking transformed futures and grounds the interventions proposed in Chapter 22 with existing examples. The following sections provide background information on cross-level interactions in sub-global assessments and existing research on aggregating local practices towards effective implementation of the SDGs. The later sections describe the methodology used for the GEO-6 bottom-up analysis, followed by the assessment findings and insights gained from the analysis.

23.2 Integrating global assessments and bottom-up analyses

The assessment of transformation pathways can be conducted from global to local, or from local to global levels. For example, Chapters 21 and 22 present global scenario and pathway analyses, but such analyses can also be conducted at local and regional levels. Additionally, pathways can be formulated from the bottom-up by using existing, potentially transformative initiatives as a starting point (Pereira *et al.* 2018b). As described in Chapter 22, global scenarios integrate models and data at the global scale to project plausible future pathways and outcomes. These methods are used to explore a wide range of possible futures (explorative scenarios), and the impacts of recommended solutions or policy options (target-seeking scenarios) (van Vuuren *et al.* 2012; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES] 2016). Most global approaches and integrated assessment models cannot, however, engage effectively with: (1) the roles and behaviour of specific actors and the multilevel political mechanisms that support transformation, (2) disruptive technologies and, (3) geographic disaggregation.

Participatory, local scenario approaches can, in contrast, use existing narratives and initiatives to imagine and observe actor behaviour, consider disruptive change and develop future pathways that are locally contextualized and practical (Merrie *et al.* 2018). However, these local scenarios face the challenge of scaling up and transferring the accumulated knowledge and results from individual cases, from local to regional and global levels. Further, local approaches lack the specificity of model-based approaches since they are often only partially quantified or aggregated, limiting their applicability at higher levels.

From these alternative starting points, multilevel scenarios can be developed in two directions. Global scenarios can be downscaled in a top-down manner for use at regional and local levels; and local scenarios can be aggregated through bottom-up approaches to complement global scenarios by inserting local contexts to address biases and assumptions. The downscaling of global scenarios has been investigated and published widely (Zurek and Henrichs 2007; Mason-D'Croz *et al.* 2016; Palazzo *et al.* 2017). The creation of global scenarios through the aggregation of bottom-up approaches or through other innovative scaling up of local scenarios has, by contrast, received little research attention. This area offers many potential benefits for integrating more imaginative futures across scales in global environmental assessments to provide more useful information for informing policies and decisions (Bennett *et al.* 2016).

23.3 Sub-global assessments in a multilevel context

Regional or sub-global assessments based on top-down scenarios offer useful insights and experience on navigating multi- and cross-scale dynamics. There are significant challenges associated with the creation and connection of scenarios across different scales and levels, but also significant opportunities for greater policy relevance. The existing literature has mostly assumed that higher-level (global) scenarios can serve as a framework for lower-level (regional, national or local) scenarios in five ways (Zurek and Henrichs 2007; Table 1. p.1292):

i. scenarios between different levels are viewed as being *equivalent* in all aspects if what is considered true at the global level is also true at the local level;
ii. they are *consistent* when all the key assumptions that frame global scenarios can be used to constrain local-level scenarios. This is generally how regional GEO assessments were developed prior to GEO-6 (i.e. the Regional Assessments discussed in this chapter);
iii. less directly connected scenarios are considered *coherent* if they share some, but not all, basic assumptions about the future across all levels – with other assumptions typically being specific to each level. An example is a set of regional scenarios created with West African policy concerns in mind but connected in terms of some key assumptions to the global scenarios developed by the Intergovernmental Panel on Climate Change (IPCC) community (See Palazzo *et al.* 2017);
iv. *comparable* scenario sets investigate the same scope of topics and issues, but are not connected in terms of key assumptions about the future. The regional IPBES assessments followed this process to a certain extent by using scenario archetypes as tools for comparison across the different regions (Sitas and Harmáčková *et al.* submitted for publication); and
v. *independent* scenarios may extend this further, based on different concerns and focus.

The scientific literature demonstrates how higher-level scenarios can be integrated with more local scenario sets – with scenario links ranging from those that are close to equivalency (Kok *et al.* 2015) to those having comparable scenario sets (Mason-D'Croz *et al.* 2016). There is a major gap, however, in the existence of studies that use local- and regional-level scenarios to inform global-level scenarios through a bottom-up approach. This is a major new focus for the outlooks presented by GEO-6.

Both GEO and IPBES share an interest in bottom-up future scenarios (IPBES 2016; Rosa *et al.* 2017; Lundquist *et al.* 2017). IPBES regional assessments offer an important point of comparison that include a broad review of sub-global scenarios and pathways efforts – **(see Box 23.1)**. Another highly relevant example of the use of regional pathways and scenarios is the CGIAR Research Program on Climate Change, Agriculture and Food Security (Vervoort *et al.* 2014). This enables understanding of how pathway development can be directly connected to policy formulation across different sub-global regions.

Box 23.1: IPBES and bottom-up scenario processes

The IPBES methodological assessment on scenarios and models explored the basis for how scenarios can be employed as tools for decision-making (IPBES 2016). Like GEO, IPBES aims to link science with policy on a variety of scales through Regional Assessments, which are used as a scientific knowledge base for policy development. Generally, IPBES focuses on the planet's state related to biodiversity, ecosystems and nature's contributions to people, grounded in interactions between the human and non-human world (Pascual *et al.* 2017). Findings of the regional assessments show that ecosystems, and consequently their services, are increasingly degrading, thus there is high need for policies addressing this challenge to be investigated from the local to the global (IPBES 2016). IPBES is undertaking scenario reviews both at global levels (IPBES Global report in preparation) and regional levels (IPBES 2018a; IPBES 2018b; IPBES 2018c; IPBES 2018d), allowing for a more specific focus on how bottom-up futures can contribute to global narratives and assist with better understanding of how to achieve more desirable futures, coupled human-nature systems and sustainable development (Lundquist *et al.* 2017).

There is increasing consensus in the literature that scenarios could be made more useful, especially in the IPBES process, through the creative development of more stakeholder-engaged bottom-up, diverse, multi-scale scenarios that are consistent within a global scenario context (Kok *et al.* 2016; Rosa *et al.* 2017). This has been reinforced in the findings for a need to build capacity in the role of scenarios in decision-making – a key finding in some of the IPBES regional assessments (See IPBES 2018a; IPBES 2018b). In response to this, the IPBES 3c Expert Group on scenarios and modelling decided on a way forward to start filling in the gaps on scenario exercises (Rosa *et al.* 2017).

The expert group recognized that:

1. scenarios fail to incorporate policy objectives related to nature conservation and social-ecological feedbacks
2. scenarios are typically relevant at only a particular spatial level, and
3. nature and its contributions to people are treated as the consequence of human decisions rather than being at the centre of the analysis (Lundquist *et al.* 2017).

To address these issues, the expert group initiated the development of a set of multiscale scenarios for nature futures based on positive visions for human relationships with nature. The first step in this process was a visioning workshop with multi-sectoral stakeholders and experts (4-8 September 2017 in Auckland, New Zealand; see Lundquist *et al.* 2017). Using an adapted Manoa mash-up approach based on Pereira *et al.* (2018a), the workshop resulted in seven visions of positive nature futures based on a bottom-up scenario approach that will be further developed in the workplan of the expert group. The process of refining the visions into scenarios that can have a quantitative element for modelling, as well as for filling in gaps, will involve iterative cycles of visioning, stakeholder consultation and modelling through a variety of different forums (Lundquist *et al.* 2017).

23.4 Bottom-up futures based on existing local practices

The need to consider the contributions of bottom-up initiatives is being recognized formally in global assessments. This demonstrates both political commitment to bottom-up implementation and the potential offered to achieve environmental goals, such as decarbonization by 2050. In the Fifth Assessment Report of the IPCC, Chapter 12 on human settlements, infrastructure and spatial planning acknowledged the role of local actors in global climate mitigation (Seto *et al*. 2014). The United Nations Environment Programme synthesis report of the Emissions Gap Report 2016 included, for the first time, an assessment of multiple studies that quantified the additional contribution of local actors to mitigation (United Nations Environment Programme [UNEP] 2016). This analysis found that subnational and non-state actors could reduce emission by an equivalent 0.4-10.0 gigatons of CO_2 in 2020. These cuts would help to narrow the 12-14 Gt gap in 2030 between national governments' emissions cuts and what global scenarios specify is needed to avoid a 2°C increase in global temperatures, although, the latest IPCC report emphasises the need to garner global action towards a 1.5°C target (IPCC 2018). In September 2018, Jerry Brown, the governor of California and, Michael Bloomberg, the former mayor of New York City, hosted a Global Climate Action Summit that highlighted the role that could be played by diverse actors such as universities, civil society organizations, businesses and local governments through bottom-up and participatory processes to address climate change (Global Climate Action Summit 2018). The critical role of cities in climate adaptation and mitigation has also been identified in a report by the Urban Climate Change Research Network that identifies pathways to sustainable urban transformations (Rosenzweig *et al.* 2018).

Several approaches for bottom-up futures identify local practices and small-scale sustainability initiatives at varying geographic levels and across sectors. At the global level, the Seeds of Good Anthropocenes and Climate CoLab projects are two examples of such initiatives. The Seeds of Good Anthropocenes project is developing a collection of local, social, technological, economic, ecological and social-ecological initiatives to help envision positive environmental futures (Bennett *et al.* 2016). Climate CoLab is an online platform for anyone to submit and discuss climate change solutions (Malone *et al.* 2017). While the Seeds of Good Anthropocenes project focuses on the identification and investigation of the practices of local initiatives, Climate CoLab focuses primarily on the process of initiative identification, development and evaluation through a crowdsourcing mechanism. An example of a sector-specific global database is the World Overview of Conservation Approaches and Technologies (WOCAT). The WOCAT network was established in 1992 to compile, document, evaluate, share, disseminate and apply knowledge for sustainable land management (WOCAT 2018). It was a trendsetter in recognizing the vital importance of sustainable land management and the pressing need for corresponding knowledge management. In early 2014, it was officially recognized by the United Nations Convention to Combat Desertification (UNCCD) as the primary recommended database for best practices in sustainable land management.

Regionally, three European Union projects, namely TESS, TRANSMANGO and PATHWAYS, have also collected local initiatives on a variety of environmental themes. TESS developed a database of small-scale social innovation initiatives in Europe focused on climate change (TESS 2018), while TRANSMANGO focused on food sustainability (TRANSMANGO 2018), and PATHWAYS developed a database on local and regional transitions for a sustainable, low-carbon Europe (PATHWAYS 2018).

The Seeds of Good Anthropocenes initiative calls for "seed-based" scenarios in which collected bottom-up initiatives are scaled up, out and deep (Bennett *et al.* 2016), with the first activities recently completed (Lundquist *et al.* 2017; Pereira *et al.* 2018b). Climate CoLab and TESS do not explore initiatives through scenarios explicitly, but Climate CoLab has conducted experiments in which the public has been invited to integrate local proposals to create national-level climate action plans for many countries and regions of the world (Malone *et al.* 2017). Meanwhile, TRANSMANGO and PATHWAYS have built bottom-up scenarios. The TRANSMANGO project based these on 18 case studies to explore local future pathways to sustainable food systems. By contrast, PATHWAYS integrated knowledge from its database into its development and analysis of transition pathways, but did not base these pathways on combinations of initiatives. While there are a variety of databases of bottom-up initiatives that could be used for building bottom-up or seeds-based scenarios, no global scenarios relevant to all aspects of environmental change are specifically based on such seeds. Methodologies from the Seeds of Good Anthropocenes and TRANSMANGO (Hebinck *et al.* 2016; Hebinck *et al.* 2018; Pereira *et al.* 2018a) provide a starting point for developing such bottom-up global scenarios. The related literature on bottom-up planning and decision-making (Fraser *et al.* 2006; Reed, Fraser and Dougill 2006; Reed 2008; Kuramochi, Wakiyama and Kuriyama 2016; Nemoto and Biazoti 2017) and crowdsourcing (Wiggins and Crowston 2011; Gellers 2015; Vasileiadou, Huijben and Raven 2016), provide useful guidelines for the methods used in this chapter.

23.5 Methodological rationale and approach

Part of the conceptual basis for this chapter is the notion that global integrated assessments and bottom-up processes drawing on innovative practices have complementary benefits, and that their connection offers unique insights **(Table 23.1)**. As outlined in Chapter 22, global, quantitative simulations of pathways towards the SDGs have the benefit of offering a strong numeric understanding of the global changes needed to reach these goals, and of unexpected positive and negative impacts that attempts to create these changes may have. Such global pathways also have the benefit of offering a context whereby global drivers of change- like those captured by the no-intervention scenarios presented in Chapter 21- can be considered. As a complementary approach to these global assessments, this chapter assesses three complementary modes of analysis:

i. an assessment of existing platforms featuring bottom-up sustainability initiatives;
ii. the assessment of local practices through illustrative examples of crowdsourcing and participatory approaches; and

iii. analysing sub-global interventions for shifting to more sustainable futures, as highlighted by sub-global/regional assessments **(Figure 23.1)**.

The analysis of local-level initiatives offers to support global pathways in tangible examples and mechanisms for change – especially when based on initiatives that are already occurring, even if in pilot or niche form. Sub-global assessments offer regional specificity while still providing broadly applicable meso-level context for national and local pathways.

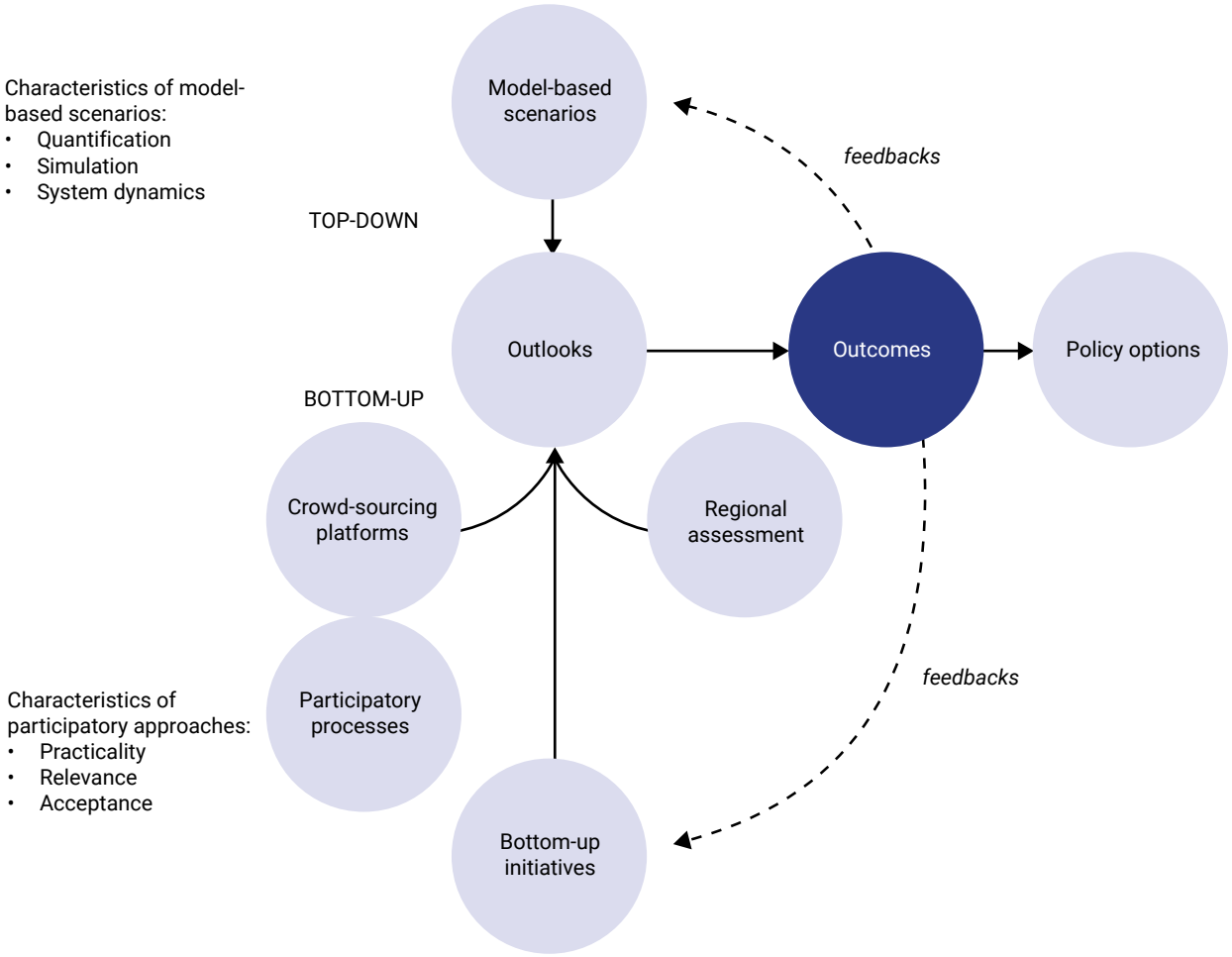
23.6 Investigating the broad landscape of bottom-up initiatives

The broader landscape of bottom-up initiatives not captured in the participatory processes is diverse, but methods for capturing this diversity are limited due to data availability. A range of platforms that collate a variety of environment- and sustainability-related bottom-up initiatives has been identified through an online search and coded. While not exhaustive, Annex 23-1 provides a sample of around 20 bottom-up initiative

Table 23.1: Different types of assessment model

Global integrated assessment model	❖ Global context ❖ Integration of many dimensions of change ❖ Simulation of effects of global interventions ❖ Quantification of magnitude of challenges
Subglobal	❖ Regional contextualization of interventions in terms of physical, economic, political and cultural conditions, challenges, opportunities
Synthesis of local practices	❖ Populating macro-level interventions with the 'who and how' – the many actors and innovations that provide feasibility to global and regional pathways

Figure 23.1: Outline of how this chapter's bottom-up approaches complement the top-down findings of Chapters 21 and 22 and how together they can offer policy insights for Chapter 24



platforms. These were identified through Internet searches using keywords that included "sustainability platform" and "bottom-up environmental initiatives" as well as through prior knowledge of initiatives. These platforms are led by a range of both non-government and government actors and provide a preliminary understanding of the breadth and range of ideas, actions and programmes that seek to implement and to help achieve sustainable development objectives.

23.7 GEO-6 participatory initiatives

Two participatory processes were organized to develop bottom-up pathways focusing on concrete system transformations. These pathways were developed to complement global integrated assessment models and are based on a diversity of potentially transformative on-the-ground practices and knowledge. These pathways also help to connect GEO-6 to stakeholders globally. The first participatory process was a series of workshops held in Bangkok, Guangzhou, Nairobi and Singapore, where local stakeholders were invited to envision specific transformation pathways based on local practices, within the frameworks of the three pathways of Roads from Rio+20 (PBL Netherlands Environmental Assessment Agency 2012): global technology, decentralized solutions, and lifestyle change (UNEP 2017a; UNEP 2017b; UNEP 2017c; UNEP 2018). The second participatory process was an online contest held in conjunction with the Climate CoLab platform (see **Figure 21.9: Global mean temperature increase**; Climate CoLab 2018). The contest asked participants to combine existing proposals within the Climate CoLab platform to build creative combinations of actions that can achieve climate change goals alongside other SDGs.

As a new and innovative aspect of GEO-6, this chapter and the participatory initiatives offer an illustrative assessment of how participatory actions can add stakeholder perspectives and on-the-ground knowledge to integrated assessment models. This analysis therefore has two goals: (1) it helps to link bottom-up and top-down perspectives on transformative systemic change for future GEO reports, and, (2) it provides insights on potentially impactful existing practices that could help to achieve transformative change towards sustainability.

From the four workshops and the Climate CoLab contest, three different types of data were gathered: innovative practices and concepts (called seeds), a combination of seed ideas into larger proposals that focused on specific system changes, and Climate CoLab proposals (these are proposals that combined existing ideas within the platform in new and innovative ways). Seeds are examples of existing, but not yet dominant social initiatives, new technologies, economic tools or social-ecological projects, or organizations, movements or new ways of acting that appear to be making a substantial contribution towards creating a future that is just, prosperous and sustainable (Pereira *et al.* 2018a). The workshops collected seeds and asked participants to build proposals for how to achieve as many SDGs as possible by combining those seeds with one another and exploring how they could interact (UNEP 2017a; UNEP 2017b; UNEP 2017c; UNEP 2018). Both the seeds and the combined proposals were framed around one of the three Roads from Rio+20 pathways mentioned above (See PBL Netherlands Environmental Assessment Agency 2012 and Chapter 22). The four workshops led to 156 seeds and 24 proposals for specific system transformations; and the Climate CoLab competition led to 70 proposals, from which judges selected 34 semi-finalists, 12 finalists and two winners (one selected by public vote and one by the judges see **Figure 21.9: Global mean temperature increase** and **Box 23.4**).

To assess the outcomes of the participatory process, the seeds and the Climate CoLab semi-finalist proposals were coded along the five dimensions summarized in **Table 23.2**. These dimensions were selected to best capture the diversity of results and to integrate results with Chapter 22. As an iterative and participatory process, seeds and proposals were coded based on the availability and quality of the data submitted, so

Box 23.2: Climate CoLab

Climate CoLab is an online contest platform and community run by the Massachusetts Institute of Technology (MIT) Center for Collective Intelligence, with the goal of harnessing the collective intelligence of thousands of people from all around the world to address global climate change. People work on the platform with each other and with over 800 experts on climate change and related topics, to create, analyse and select detailed proposals for what to do about different aspects of the climate change problem. The Climate CoLab site has over 100,000 registered members and has received over 2,500 proposals.

The contest, given the title Exploring Synergistic Solutions for Sustainable Development, began accepting submissions on November 1, 2017, and invited anyone to submit proposals answering the question: "What combinations of Climate CoLab proposals could help achieve multiple SDGs?"

The judges' contest was promoted through a wide range of networks, including through UN Environment, MIT and other organizational partners worldwide, as well as being promoted to the Climate CoLab community itself. The judges selected 12 finalists plus a judges' choice winner out of these. The global public was also invited to vote for the proposal most deserving of a popular choice award out of the 12. These winners were announced on 15 March 2018 **(See Box 23.4)**.

Contest statistics:

- 73 proposals submitted
- 112 proposal authors (individuals or as part of a team)
- 188 proposal comments submitted by experts, authors and other members
- 3,064 valid votes cast

See the contest web pages at: http://www.climatecolab.org/contests/2017/exploring-synergistic-solutions-for-sustainable-development

Source: Climate CoLab (2018).

Table 23.2: Coding dimensions

Dimension	Categories	Description
Initiative benefits	17 SDGs	Coding by SDGs captures the range of benefits for each of the seeds and proposals. Results identify the diversity of outcomes and potential SDG synergies.
Global measures category	41 global "measures" or "interventions" (as referred to in this chapter when describing specific initiatives) broken down into five system-focused clusters	Results were categorized under the 32 measures identified in Chapter 22 along with nine additional interventions, identified during the coding process, that did not fit neatly under any of the existing 32 measures. The clusters for freshwater and for oceans were grouped together due to low representation in the results.
Theory of change	❖ New technology ❖ Decentralization ❖ Design/infrastructure ❖ Monitoring and reporting ❖ Change in production practices ❖ Lifestyle change ❖ New organization/business ❖ Knowledge/data platform ❖ Policy change ❖ Finance/incentives/subsidies ❖ Awareness, knowledge, skills development	The theory of change identifies the type of change or solution of the initiative. These categories are based on an iterative coding process of results to best capture the diversity while minimizing overlapping categories.
Actor	❖ International organizations ❖ Governments (local, regional, national) ❖ Private sector/businesses ❖ Civil society ❖ Academic and research institutions ❖ Households/individuals	The type of actor focuses on their involvement in each of the initiatives.
Geography (only for Climate CoLab semi-finalists)	❖ By country	The country or countries where the initiative would be deployed and where the authors originated.

not all the results could be coded on all dimensions. It should also be noted that some dimensions were self-identified by the contributors, while others were specifically coded by the GEO author team.

23.8 GEO-6 Regional Assessments

Six GEO Regional Assessments were completed in 2016: for Africa, Asia and the Pacific, Europe, Latin America and the Caribbean, North America, and West Asia. These can be viewed as intermediate assessments between global and local assessments. Each Regional Assessment highlights region-specific environmental challenges and the key interventions for addressing them. When viewed together, these assessments provide a global set of overarching challenges and responses for securing a more sustainable future that still retain certain regional priorities. In this chapter, we compare the key interventions identified in the six regions with those identified from the review of the scenario literature (Chapter 22) and the bottom-up processes **(Figure 23.15)**. By doing so, we aim to identify potential gaps in the interventions considered at all three levels of assessment (global, regional and local), and to draw insights that enhance the range of interventions and policy options available to decision makers.

In a similar way to participatory initiatives, key interventions identified in the Outlooks chapters of the GEO Regional Assessments were coded according to the interventions identified by the review of the scenarios literature (Chapter 22, **Table 22.1**). Interventions that were not on the predefined list from the scenario literature review were added to derive an updated list of interventions.

23.9 Findings from a bottom-up approach

23.9.1 Broader bottom-up platforms and the diverse actors needed for change

National governments throughout the world have begun to recognize that sound climate scenario modelling and assessment require contributions from bottom-up sources (Hsu *et al.* in press). Global emissions trajectories modelled from top-down integrated assessment models (van Vuuren *et al.* 2011) do not explicitly incorporate information from bottom-up initiatives and individual contributions from local governments, businesses and civil society organizations. Top-down emission pathways assume that these mitigation efforts are subsumed into national government pledges, but bottom-up actors make climate commitments that could be considered additional to or outside of national climate efforts, complicating the assessment of climate mitigation scenarios (Hsu *et al* 2015; Jordan *et al.* 2015). Compounding this complexity, individual actors frequently form hybrid coalitions, often in cooperation with national governments, building transnational climate governance networks. These partnerships demonstrate the potential additive effects of individual bottom-up climate

actions when actors align targeted goals and coordinate efforts (Andonova, Betsill and Bulkeley 2009).

In December 2014, the United Nations Framework Convention on Climate Change (UNFCCC) launched the Global Climate Action portal (also known as NAZCA after its former name, the Non-state Actor Zone for Climate Action) in an effort to capture and track the diversity of bottom-up actors and commitments pledging climate mitigation, adaptation, financing, capacity-building and other actions to address climate change (UNFCCC 2018; see **Box 23.3**). The Global Climate Action portal was initially developed to illustrate an 'all hands on deck' approach (Hale 2016) to climate governance, and the scientific and analytical community is now moving towards a consistent methodology to account for quantifying bottom-up actor contributions in global climate mitigation scenarios (Initiative for Climate Action Transparency [ICAT] 2018; Hsu *et al.* in press). This effort is intended to serve multiple objectives:

i. quantifying the global aggregation of bottom-up climate efforts and its additional impact in existing climate scenarios will allow for more accurate appraisal of existing emission pathways and gaps.
ii. understanding the mitigation contributions of bottom-up efforts will provide national governments with additional information by which to leverage more ambitious Nationally Determined Contributions to the Paris Climate Agreement in review cycles (UNFCCC 2015). This knowledge of decentralized impacts could also prompt and enable governments to better support and scale up these activities.
iii. incorporating bottom-up initiatives into global climate scenarios will provide recognition of small-scale initiatives or qualitative contributions (e.g. capacity-building) that are critical to advancing lower-carbon trajectories but are difficult to quantify (Chan, Brandi and Bauer 2016).

Results from the analysis of bottom-up platforms

Over 50,000 individual bottom-up actions were identified, but their different structures and goals made comparisons challenging. Evaluating platforms, rather than individual commitments, helped to facilitate comparisons between different kinds of bottom-up action, and also to shed light on the structures in place to enable and support the continued growth and development of these initiatives. The platforms identified through the online search range from the Amazon Vision Coordination and Information Platform, which is based in Colombia and includes more than 200 initiatives that support the implementation of mitigation activities against greenhouse gas emissions (GHG), to Sustainia 100, which has tracked more than 4,500 sustainable solutions being deployed by 188 companies. The aims of these platforms vary, from providing crowdsourcing solutions to listing microfinancing options, to giving information that connects stakeholders **(Figure 23.2)**. Platforms often seek to support or feature initiatives from a wide range of actor types while others have a narrower focus on a particular type of actor, such as business. Drawing examples from all over the world, all but five platforms have a global level of coverage. The five non-global initiatives focus on city (MTLGreen), regional (Amazon Vision Coordination and Information Platform, MACBIO – Pacific) and national (e.g. WorthWild, GreenCrowd) issues.

The majority of the platforms considered, facilitated knowledge-sharing and the identification of solutions in two ways. One was through the collection of examples, solutions and best practices (e.g. UNFCCC Momentum for Change Lighthouse Initiative, PANORAMA Solutions for a Healthy Planet), and the second was by creating forums for sharing technical or regional tools and know-how, to support a wide range of on-the-ground activities (e.g. Biofin Knowledge Platform, ClimateTechWiki). Still other platforms used contests or crowdsourcing to generate and synthesize solutions to challenging questions (e.g. VertMTL, MIT Climate CoLab). Fewer platforms focused on tracking the progress or impacts of activities (e.g. REDDX) or on enabling project implementation by matching projects with funds or other forms of technical or capacity support (e.g. WorthWild, Greencrowd, Divvy, LifeWeb Initiative).

The coding analysis revealed a wide variety of actors working at all scales to implement the SDGs **(Figure 23.3)**. The platforms we identified are convened, curated or led mainly by a range of non-government and government actors, and primarily facilitate knowledge-sharing and the identification of solutions between bottom-up initiatives. These spaces may provide an important route for scaling solutions out, and could lay the foundations to scale solutions up, by collecting and distilling best practices and innovative solutions. Creating forums for collaboration and exchange may also help to facilitate loose coordination and a mutually beneficial division of labour between different actors. Abbott's (2012) research on transnational initiatives, for example, finds that many coalitions perform activities that national governments may be less suited to implement, such as information-sharing and capacity-building.

Box 23.3: The Global Climate Action portal

The Global Climate Action portal, also known as NAZCA, is an online platform currently featuring more than 12,000 commitments to climate change action made by local governments, businesses, civil society organizations, higher education institutions and investors. These range from individual companies adopting internal carbon prices to constrain emissions growth, to city governments pledging carbon neutrality. The Global Climate Action portal also includes initiatives like the World Food Programme's R4 Rural Resilience Initiative (World Food Programme 2018), which aims to increase resilience to climate change through an integrated risk management system for 100,000 farmers. By far the most numerous bottom-up actor types in the portal are subnational and local governments, with close to three-quarters of cities in the platform located in Europe (Hsu *et al.* 2016). This geographic overrepresentation of bottom-up actors in the global North, due to a lack of reported data, is one of the major limitations of efforts to understand the scope of climate action. The vast majority of the climate commitments are focused on emission reduction targets, with 85 per cent of subnational efforts and close to 40 per cent of corporate actions addressing climate mitigation. Most of the actions in the Global Climate Action portal recognize the role of local efforts to promote clean energy production and alter the consumption systems that are responsible for global climate change.

Figure 23.2: The number of initiatives covered in a sample of platforms that feature bottom-up sustainability initiatives (see Annex 23-1 for a brief description of the platforms)

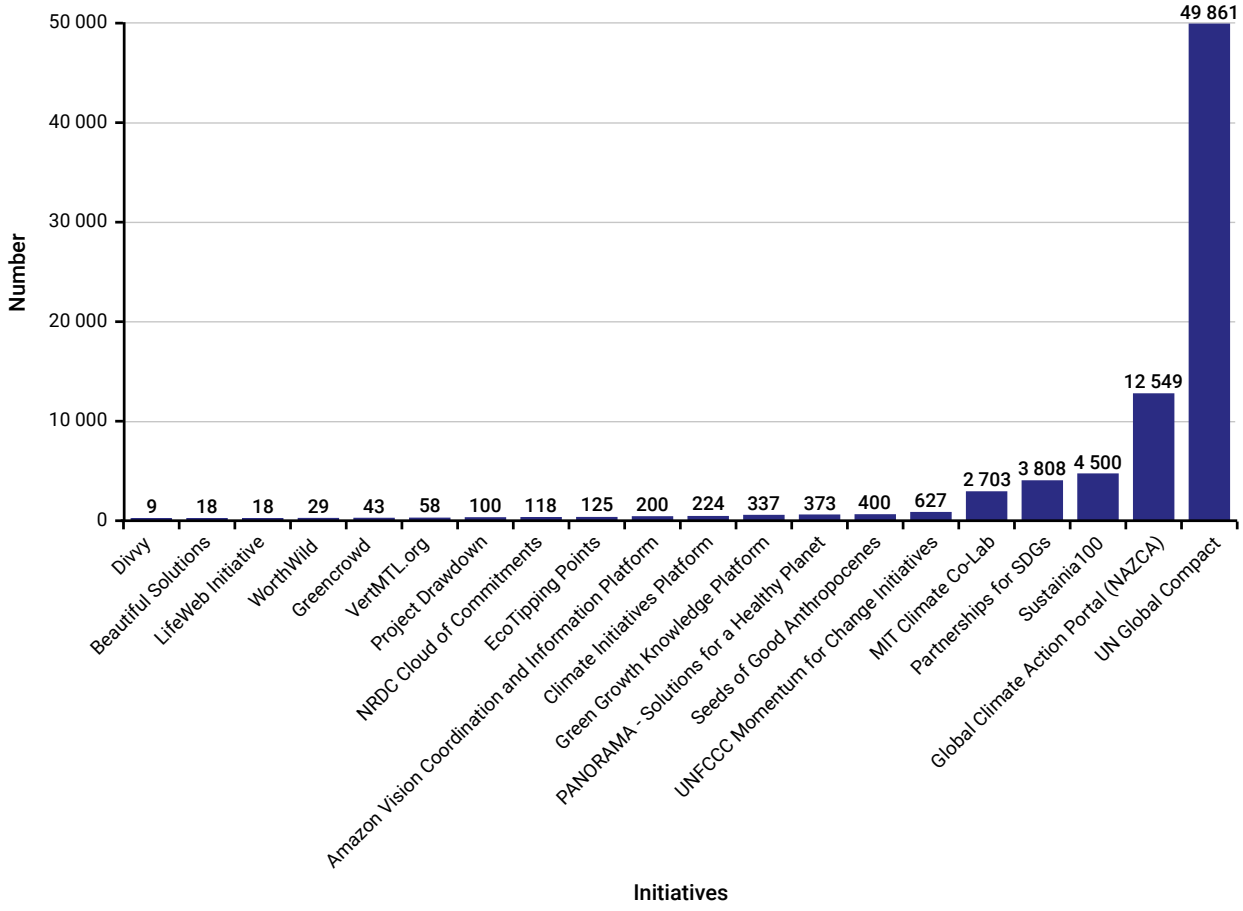
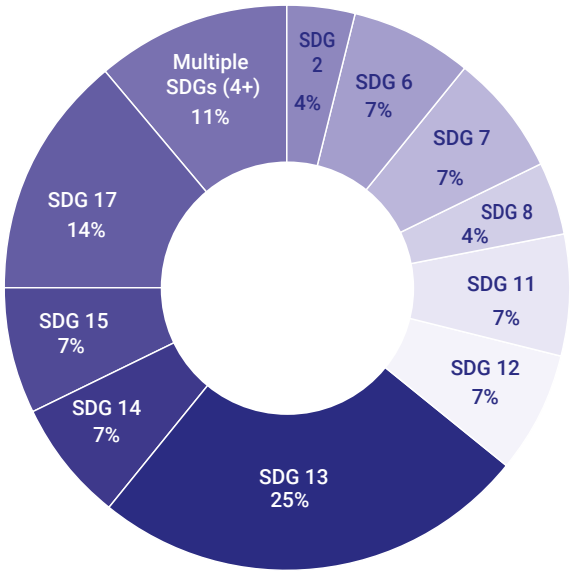


Figure 23.3: The SDGs represented proportionally by how they are covered by the selected bottom-up sustainability initiative platforms. Some initiatives are narrower in scope and strictly relate to one, two or three SDGs, while others are diverse and capture a wider range of SDGs (four or more) (see Annex 23-1 for a brief description of the initiative platforms)



23.9.2 Participatory processes

While Section 23.10 outlines the array of platforms that are already collecting initiatives with the potential to help meet the 2030 Agenda for Sustainable Development, this section presents results from the participatory workshops and Climate CoLab crowdsourcing that further bring to light the diversity of solutions found globally. These initiatives were identified as concrete examples of typical solutions in the measure categories outlined in Chapter 22. They also challenge some of the assumptions of how change happens within top-down models, and highlight the interrelated trends of SDGs, their potential synergies, and the role of diverse actors in achieving the 2030 Agenda – while the top-down models help focus on trade-offs. This section first provides an overview of trends found across all workshop seeds and Climate CoLab proposals before breaking down the results by the four clusters studied in Chapter 22. In addition, a fifth cluster of measure/intervention categories was created based on the solutions found in the bottom-up work that did not neatly fit within those four existing clusters – these are discussed more fully in Section 23.10. The assessment demonstrates the potential of bottom-up initiatives to aid policymakers and top-down analyses, but, due to the limited sample size it does not present a comprehensive overview of all on-the-ground solutions globally.

General landscape of initiatives

SDGs

The workshop seeds and Climate CoLab proposals targeted all 17 SDGs to varying extents. **Figure 23.4** highlights the range of SDGs that were found in the analysis. In the case of the workshop seeds, SDG 12 (responsible consumption and production) and SDG 11 (sustainable cities and communities) were most represented. As for Climate CoLab proposals, SDG 13 (climate action) was targeted by over 80 per cent of proposals, followed by SDG 3 (good health and well-being).

Actors

Workshop seeds focused most on government actors, private sector/business and households/individuals **(Figure 23.5)**. Over 60 per cent of workshop seeds indicated a role for the government, with local government mentioned most, followed by national governments. Similarly, Climate CoLab proposals also emphasized the role of government, with national governments being referenced most. The importance of assessing diverse actors is elaborated further in Section 23.11.

Geography

In submitting proposals on the Climate CoLab platform, contributors were requested to identify up to five countries where their proposals would be active **(Figure 23.6a)**.

Within the 34 Climate CoLab semi-finalists the individual countries that were most covered were the Republic of Kenya (11 proposal mentions), the Republic of India (8) and the United Republic of Tanzania (7). As an open and global crowdsourcing project for solutions, the emphasis on the global South points towards a geographical inequity about where change is perceived to be needed, and highlights a need for transformations to be more equitable across regions (see Section 23.14 for a discussion on distributive justice and equitable transformations). Some of the solutions emanated from the global North for application in the global South making the case for equity particularly relevant. Although not deliberate, this trend can be seen to reinforce the narrative that the North can continue on a business-as-usual trajectory while the South develops more sustainably, and also misses out some of the nuance of how contextual the interpretation of sustainability is and how to achieve it (see Vercoe and Brinkman 2009). However, the high number of suggestions made by contributors from the Global South **(Figure 23.6b)** also points to the innovative thinking that is happening in these parts of the world, where the urgency for action towards meeting Agenda 2030 is greater (Nagendra 2018). By enabling contributions from across the globe, the participatory processes of GEO 6 could capture a range of context-specific solutions for achieving sustainable development.

Figure 23.4: SDGs targeted by the total workshop seeds and the total Climate CoLab proposals

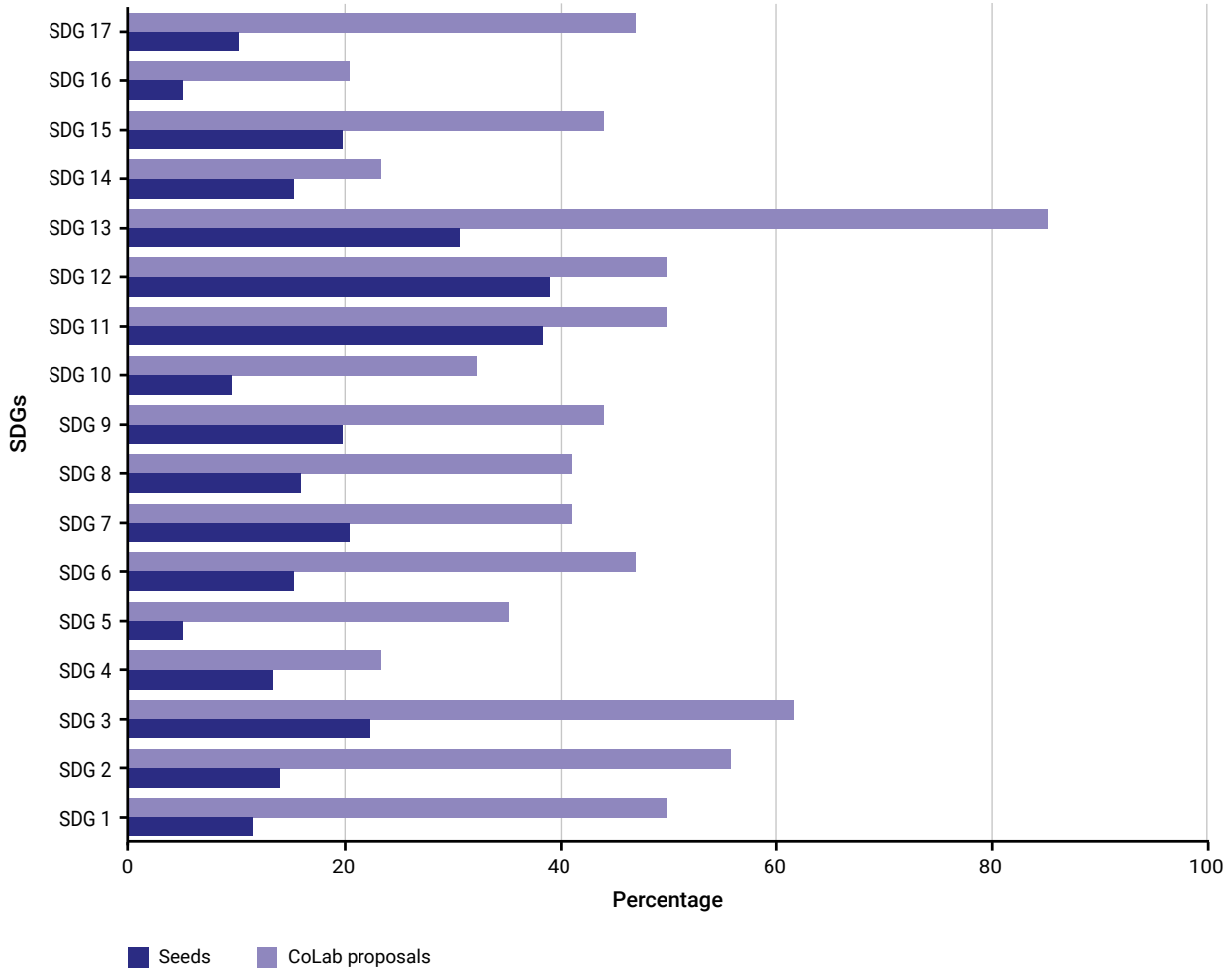


Figure 23.5: Actor types represented by total seeds and total Climate CoLab proposals

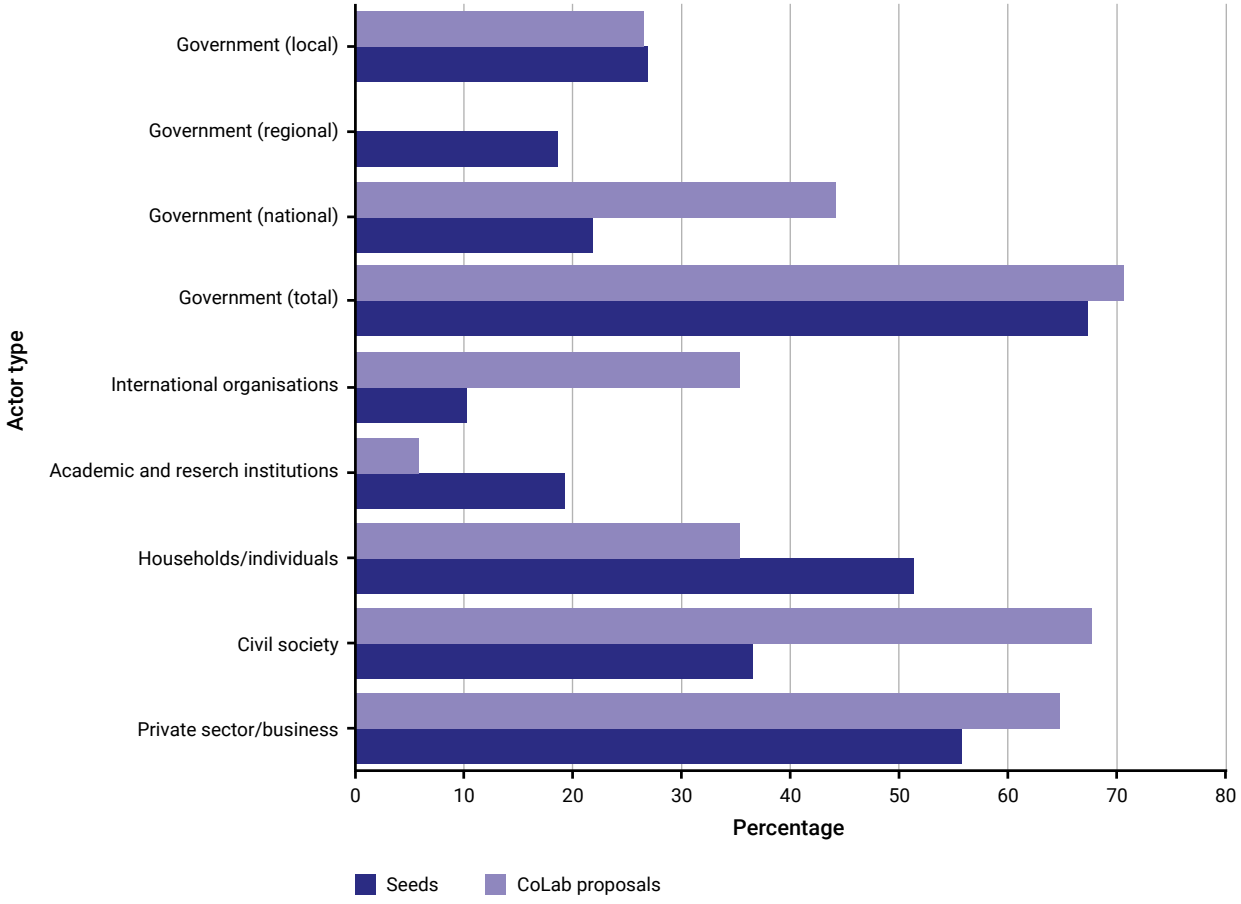


Figure 23.6a: Regions covered by Climate CoLab proposals

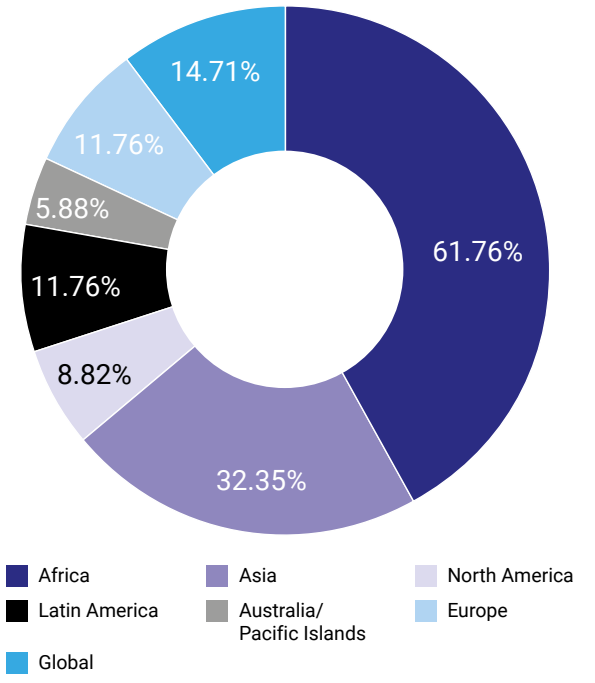
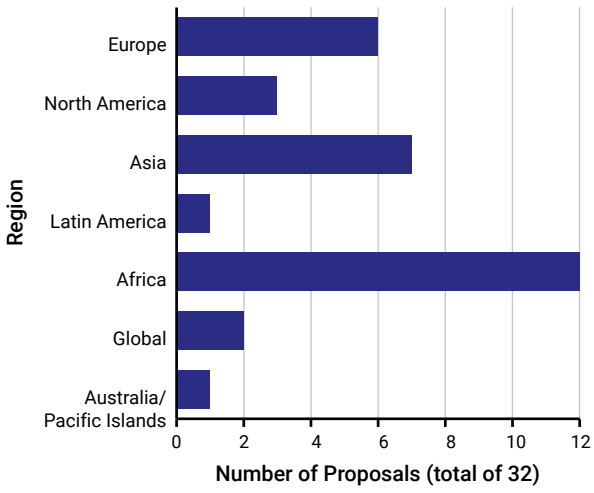


Figure 23.6b: Regional breakdown of Climate CoLab proposals



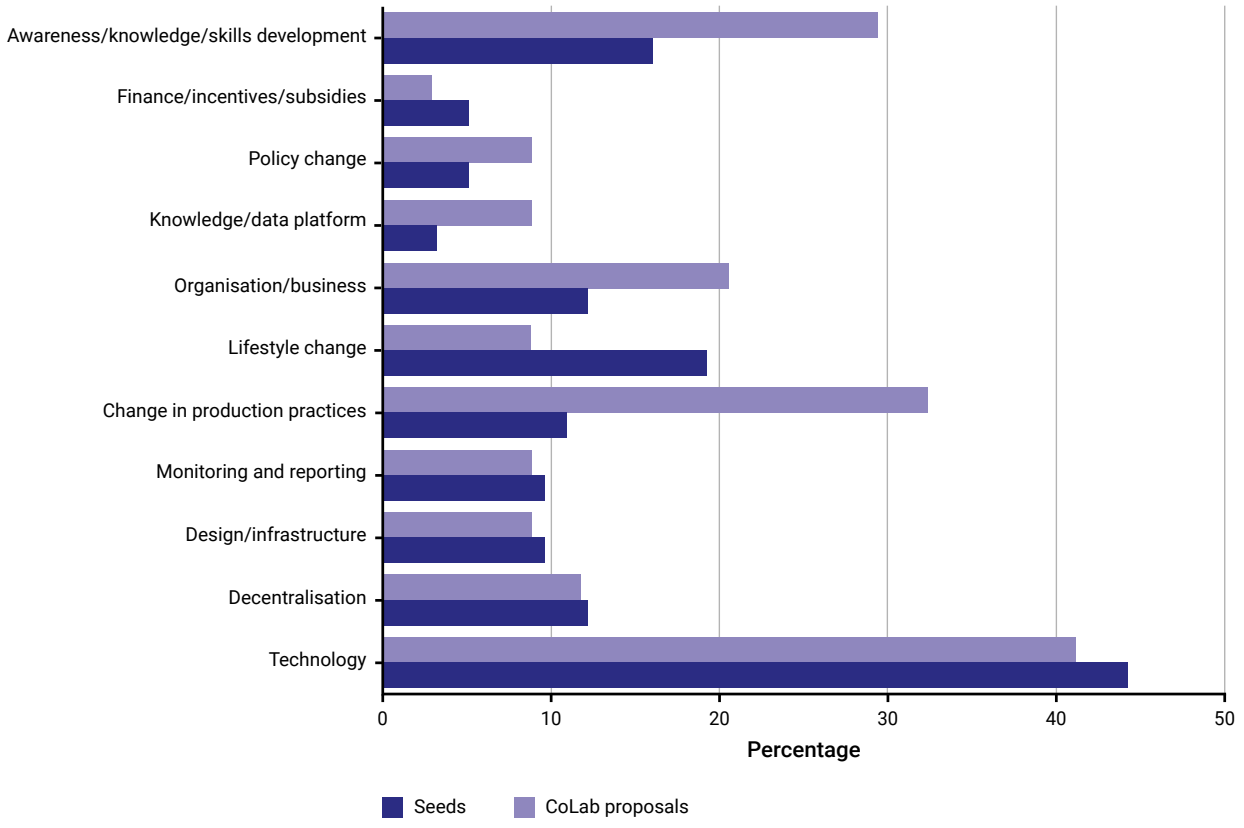
Theory of change

Seeds and Climate CoLab proposals overwhelmingly focused on new technologies to reach their desired goals **(Figure 23.7)**. Climate CoLab proposals also largely emphasized changes in production practices, thus making producers more responsible for sustainability interventions. Seeds focused more on lifestyle change and putting the responsibility on consumers rather than producers. Within the 'new technology category' there was also a large emphasis on app-based solutions. Eleven seeds and one Climate CoLab proposal proposed apps, largely to enable users to monitor and report on sustainability issues and to connect with others over them. These included the Climate CoLab proposal to enable urban dwellers to report on the quality of their environment (C'SQUARE), and seeds like a plastic waste footprint calculator app or apps to report water pollution to relevant authorities, monitor energy consumption, help report and identify plants, and several sharing economy apps related to ride-sharing, waste exchanges, and product borrowing from neighbours. The winning Climate CoLab proposals had technological innovations at their core: ClimateCoop was based on blockhain technology and The Community-Based Framework for Sustainable Development integrated existing technologies to meet multiple sustainability needs holistically (For an example see **Box 23.4**).

Clusters within workshop seeds and Climate CoLab proposals

Workshop seeds and Climate CoLab proposals were coded by types of intervention and broad clusters, according to the categories outlined in **Table 22.13** in Chapter 22. The cluster coding allows for the bottom-up initiatives to complement and reinforce the top-down analysis. As the bottom-up approaches are new to GEO-6, the following discussion is intended to be illustrative of the possibilities offered by these complementary methods. In future assessments, a larger data set could be gathered, and results linked more explicitly to the top-down efforts, and, in turn, the top-down analysis could be enhanced by including some of the findings from the bottom-up analysis. Coding was done by subjectively assigning as many intervention types as were appropriate, based on the description provided for each seed or Climate CoLab proposal; as such, it is common for multiple intervention types across more than one cluster to be represented in a given proposal. Due to low representation in the two clusters of freshwater and oceans, these have been grouped together throughout this chapter for cluster-based analysis and based on the original cluster in Chapter 22. However, it is recommended that freshwater and oceans are considered separately in future assessments.

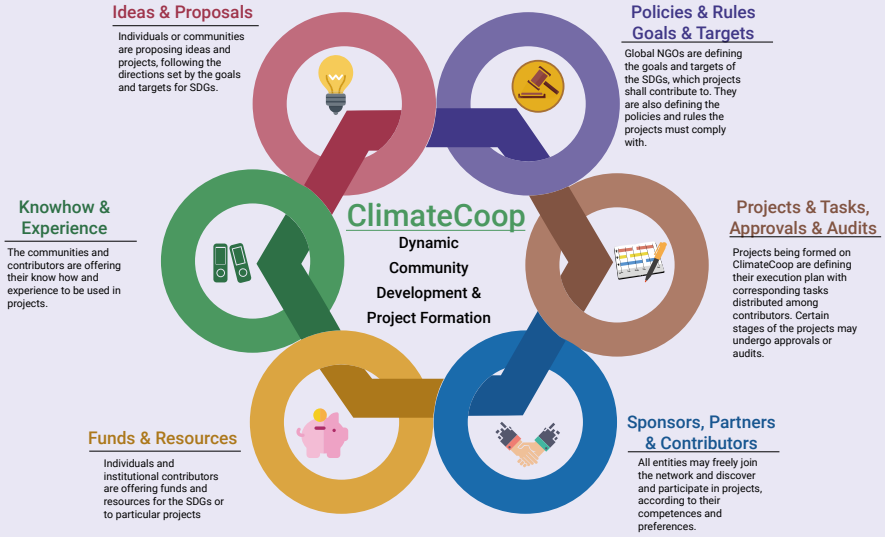
Figure 23.7: How each theory of change is represented by the total seeds and proposals



Box 23.4: Climate CoLab Winners

ClimateCoop - The Climate Consortium Blockchain (Judges' Choice Winner)

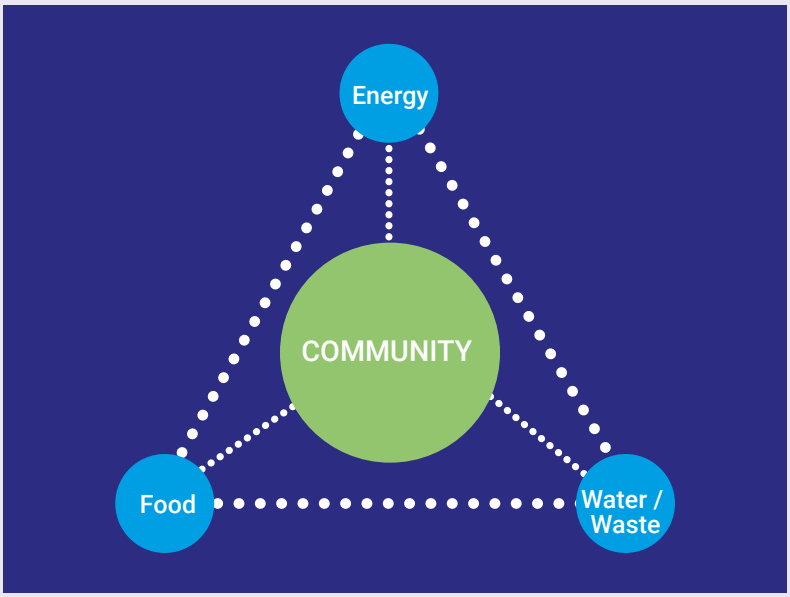
ClimateCoop is a blockchain-based platform that allows for decentralized, local, and transparent action on SDGs. This distributed platform connects interested parties (e.g. individuals, researchers, sponsors, international organizations, governments, businesses) and facilitates collaborations for new ideas and initiatives. On the platform, initiative creators can update their progress, while accredited members can review and approve future initiatives. The developers of the ClimateCoop Platform believe that their innovation utilizes the best of distributed digital technology, modern social patterns, decentralized matrix governance, and disruptive economic models (e.g. crowdsourcing) to efficiently support bottom-up climate and sustainability action. Their platform empowers individuals and institutions to cooperate and collaborate.



Source: ClimateCoop (2018)

Framework for Community-Based Sustainable Development (Popular Choice Winner)

The Framework for Community-Based Sustainable Development introduces a comprehensive, integrated roadmap for communities to pursue sustainable development. This integrated roadmap builds upon the energy, water/waste, and food sectors to create a holistic approach to community sustainability. By emphasizing the synergistic nature of infrastructure and society, this roadmap helps future development consider the "human factor" within sustainability, ensuring environmental sustainability that is community inclusive. The framework's independent components such as the development of biogas technology, vertical hydroponic farms, and rainwater harvesting are designed to be adaptable to different localities.



Source: Wright, Yang and Ma (2018).

Figure 23.8 shows that in the workshop seeds, there was strong representation of the energy, climate and air cluster, particularly linked to SDGs 7, 11 and 13. Specific interventions within the cluster are detailed below, but popular interventions related to low/zero emissions, behaviour change, energy efficiency and (to a lesser degree) energy access. The seeds showed strong representation of the various categories described as "other" (not part of the main cluster groupings identified in Chapter 22), particularly awareness and skills building, monitoring and reporting, plastics and consumer waste reduction, and circular economy, with the strongest SDG links being to SDGs 11 and 12, with slightly less strong links to SDGs 3 and 13. There was modest interest in the food, agriculture, land and biodiversity cluster, with the strongest interventions relating to diet change and protection of terrestrial ecosystems. Due to the participatory workshops taking place in cities, there was a big focus on how to meet SDGs in an urban context –**Box 23.5** provides some of these key findings from the interventions that emerged in the participatory processes.

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Box 23.5: Urban systems

GEO-6 identifies urbanization as one of five key drivers of environmental change, creating fundamental changes in natural and social systems, as well as one of 12 cross-cutting issues that require urgent and systemic responses (see Chapters 2 and 4). With around 60 per cent of the urban areas yet to be built to accommodate the urban population of 2050, it is critical to ensure that urban systems designed today are made as sustainable as possible.

The participatory results focused to a large extent on improving urban environments, with SDG 11 (sustainable cities and communities) mentioned often, by 38 per cent of all workshop seeds and half of all Climate CoLab proposals. Analysis of these results also showed a variety of SDG synergies, supporting the idea of urbanization being a cross-cutting issue in which solutions can have multiple co-benefits. Seeds addressing SDG 11 had large synergies for addressing SDGs 3, 9, 12 and 13. Climate CoLab proposals also indicated several synergies with SDG 11, including for SDGs 3, 12, 13 and 17. These coding results were further reflected in the descriptions of relevant seeds and proposals, as many spoke of a variety of co-benefits for urban-based solutions.

Urban-related seeds often focused on empowering citizens using online platforms and smartphone applications. Some apps focused on allowing users to monitor and report their energy usage, air and water pollution, to identify plant species (biodiversity), and more. A core aspect of these apps was to enable data-based action in addition to educating users. An app to monitor energy consumption incorporated monetary incentives to change electricity use habits, and an app to monitor water quality connected directly to relevant municipal water agencies. Urban seeds also focused on infrastructure, particularly on developing green infrastructure through green roofs, community gardens and green building standards more generally.

In all four workshops, seeds-based visions often coalesced around sustainable cities or communities. Urban areas were imagined in which buildings are fitted with solar panels and/or green roofs, are built with sustainable materials, and make use of smart technologies to minimize energy usage. Pathways to sustainable futures often included setting aside spaces and providing infrastructure to enable urban agriculture, the products of which could be used for food as well as for sustainable consumer goods such as biodegradable or edible cutlery. One pathway focused specifically on an international cities platform that allows for environmental data and actions to be aggregated internationally, and to be used by citizens to learn and engage in sustainable community actions.

Figure 23.8: Heat map of workshop seeds, showing pairings of specific measures/interventions and SDGs

Cluster	Measure category	No poverty (1)	Zero hunger (2)	Good health and well-being (3)	Quality education (4)	Gender equality (5)	Clean water and sanitation (6)	Affordable and clean energy (7)	Decent work and economic growth (8)	Industry, innovation and infrastructure (9)	Reduced inequalities (10)	Sustainable cities and communities (11)	Responsible consumption and production (12)	Climate action (13)	Life below water (14)	Life on land (15)	Peace, justice and strong institutions (16)	Partnership for the goals (17)
Energy, Climate and Air	Energy access	1	0	0	1	0	0	9	4	3	1	4	1	4	0	0	1	1
	Behavioural change (transport and households)	1	0	5	1	0	2	6	4	5	1	10	6	10	1	1	0	1
	End-use electrification	0	0	0	0	0	0	5	1	3	0	2	0	4	0	0	0	0
	Low/ zero emission technologies (non-biomass)	1	0	5	1	0	2	18	6	7	1	8	5	10	1	1	0	2
	Bioenergy (with and without CCS)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Improve energy efficiency	0	1	4	0	0	2	5	4	7	0	7	4	7	0	1	0	0
	Negative emission technologies	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Air pollution control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Non-CO_2 emission reduction	0	1	0	0	0	0	1	0	1	0	0	1	2	0	0	0	0
Agriculture, Food, Land and Biodiversity	Reduce food waste	0	1	1	0	0	1	0	0	0	0	1	3	1	0	0	0	0
	Yield improvement	3	4	2	0	1	0	0	1	1	0	1	2	0	0	0	0	0
	Nutrition management	0	1	2	0	0	0	0	0	0	0	1	1	1	0	1	0	0
	Food access	2	5	3	0	1	0	1	2	1	1	2	1	0	0	1	0	1
	Diet change	0	2	4	1	0	1	1	0	1	0	4	4	3	3	4	0	1
	Manage soil carbon loss	1	1	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1
	Minimize land damage	1	2	1	0	0	2	2	2	0	0	0	0	1	0	2	0	2
	Land ownership	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Protection of terrestrial ecosystems	2	2	1	0	0	3	2	3	3	0	3	1	4	2	6	0	1
	Land-use planning	1	0	0	0	0	0	0	1	1	0	2	1	1	0	1	0	0
	Forest management	1	3	1	0	0	1	1	1	0	0	0	1	3	0	4	0	0
Human Well-being	Poverty alleviation	2	1	2	1	1	0	3	4	3	3	3	3	2	0	1	1	1
	Child/ maternal healthcare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Education	2	1	2	6	0	1	0	3	0	3	1	0	0	0	1	1	2
Freshwater and Oceans	Improve water-use efficiency	0	0	0	0	0	2	0	0	1	0	0	0	1	0	1	0	0
	Blue Carbon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WASH	0	1	2	0	0	7	1	0	2	1	3	0	0	1	1	0	0
	Wastewater treatment	0	0	1	0	0	2	1	0	0	0	0	1	0	0	0	0	0
	Water quality standards	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Desalination	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Integrated water resource management	0	0	0	0	0	1	0	0	1	0	3	1	0	0	0	0	0
	Sustainable fisheries	0	1	1	0	0	0	0	0	0	0	1	1	0	1	0	0	0
	Ocean regulation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Protection of marine ecosystems	0	0	0	0	0	1	0	0	0	0	0	0	1	2	1	0	0
Other	Monitoring and reporting	3	3	10	3	1	3	3	4	6	3	8	5	3	3	5	2	3
	Circular economy	1	0	1	1	0	2	1	2	4	1	6	14	1	2	1	0	1
	Sharing economy	1	0	1	0	0	0	0	0	0	1	4	6	1	2	2	0	1
	Plastics and consumer waste reduction	1	2	3	1	0	2	1	1	2	0	6	16	8	5	5	0	1
	Awareness and skills building	3	4	8	10	4	5	5	6	6	5	12	12	10	8	7	3	6
	Gender equality	0	1	1	1	2	1	0	0	0	0	0	1	0	1	1	0	1
	Smart cities for sustainability	1	0	2	0	0	1	1	2	1	0	6	3	5	1	1	0	0
	Ecosystem restoration	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
	Effective governance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Numbers indicate the count of proposals coded with the specific pairing of intervention (row) and SDG (column). 'Other' is described more in Section 23.11

Figure 23.9: Heat map of Climate CoLab proposals showing pairings of measures/interventions and SDGs

Cluster	Measure category	No poverty (1)	Zero hunger (2)	Good health and well-being (3)	Quality education (4)	Gender equality (5)	Clean water and sanitation (6)	Affordable and clean energy (7)	Decent work and economic growth (8)	Industry, innovation and infrastructure (9)	Reduced inequalities (10)	Sustainable cities and communities (11)	Responsible consumption and production (12)	Climate action (13)	Life below water (14)	Life on land (15)	Peace, justice and strong institutions (16)	Partnership for the goals (17)
Energy, Climate and Air	Energy access	2	2	2	1	1	2	4	2	2	1	0	1	4	1	1	0	2
	Behavioural change (transport and households)	3	3	3	1	2	2	4	3	3	2	3	3	5	3	3	2	4
	End-use electrification	1	1	1	0	0	2	2	1	1	0	1	0	1	1	1	0	0
	Low/zero emission technologies (non-biomass)	3	4	4	1	2	3	5	4	2	2	2	0	5	1	2	1	3
	Bioenergy (with and without CCS)	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0
	Improve energy efficiency	2	2	2	1	1	2	1	2	1	1	2	0	3	1	1	0	1
	Negative emission technologies	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Air pollution control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Non-CO_2 emission reduction	0	1	1	0	0	1	0	0	1	0	0	1	1	0	1	0	0
Agriculture, Food, Land and Biodiversity	Reduce food waste	2	2	2	1	2	1	1	1	1	1	2	1	2	1	1	1	2
	Yield improvement	3	3	2	0	2	1	0	1	1	1	1	1	3	0	1	0	2
	Nutrition management	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Food access	7	10	10	4	6	4	6	8	3	5	4	6	10	3	6	2	8
	Diet change	0	1	1	0	0	1	0	0	1	0	0	1	1	0	1	0	0
	Manage soil carbon loss	3	3	2	1	2	3	1	1	1	1	2	1	3	1	1	1	2
	Minimize land damage	5	8	8	3	6	7	6	7	5	5	4	6	10	4	7	3	6
	Land ownership	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Protection of terrestrial ecosystems	3	5	5	2	3	5	4	4	3	2	3	5	6	3	5	1	3
	Land-use planning	1	2	2	1	0	1	0	0	1	0	0	1	2	0	1	0	1
	Forest management	2	3	2	1	1	4	3	2	1	0	1	3	4	2	3	0	1
Human Well-being	Poverty alleviation	8	9	9	3	3	5	5	7	4	4	3	5	10	3	5	1	5
	Child/ maternal healthcare	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Education	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Freshwater and Oceans	Improve water-use efficiency	1	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
	Blue carbon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WASH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Wastewater treatment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Water quality standards	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Desalination	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Integrated water resource management	1	3	3	2	3	2	2	3	0	2	2	0	3	0	1	1	3
	Sustainable fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ocean regulation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Protection of marine ecosystems	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Other	Monitoring and reporting	1	1	2	1	0	2	1	1	2	1	1	1	2	0	1	2	2
	Circular economy	3	3	5	1	3	1	1	1	2	2	4	4	4	1	2	1	2
	Sharing economy	2	2	2	1	1	1	1	1	1	1	1	1	2	1	1	1	2
	Plastics and consumer waste reduction	2	1	3	0	2	1	0	0	1	1	4	4	4	1	3	0	2
	Awareness and skills building	7	8	8	5	7	7	7	8	5	7	9	7	13	5	7	5	6
	Gender equality	5	6	7	2	7	3	3	5	1	5	6	3	7	1	4	2	6
	Smart cities for sustainability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ecosystem restoration	1	1	1	0	0	1	1	1	0	0	0	1	1	1	1	0	0
	Effective governance	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1

Numbers indicate the count of proposals coded with the specific pairing of intervention (row) and SDG (column). 'Other' is described more in Section 23.11

The cluster groupings were quite different between the seeds and the Climate CoLab proposals. In the latter, agriculture, food, land and biodiversity emerged as a very strong cluster, far more so than in the workshop seeds, with many Climate CoLab proposals targeting food access and minimizing land damage **(Figure 23.9)**. Climate CoLab proposals also focused heavily on poverty alleviation. The added intervention type, awareness and skills building, was strongly represented in both the seeds and Climate CoLab proposals. SDGs 1, 2, 3 and 13 emerge as strongly linked across many proposals. Comparatively few Climate CoLab proposals had interventions relating to energy, climate and air despite strong representation of SDG 13 (climate action). Gender equality emerged as a strong intervention in Climate CoLab proposals compared with the seeds, but it was not strongly related to any other SDG. Neither the seeds nor the Climate CoLab produced any substantial focus on the merged cluster for freshwater and oceans, although this gap is partially addressed in the analysis of the Regional Assessments.

Figure 23.10 shows the number of seeds/proposals that sit across multiple clusters. The Climate CoLab proposals were more likely to be relevant in more than one cluster, whereas the seeds tended to stay within one cluster. This makes sense because the seeds were typically single initiatives rather than a combination of interventions into one proposal. Seeds show

Figure 23.10: Inter-cluster pairings across the seeds and Climate CoLab proposals

Workshop

Cluster	Agriculture, Food, Land and Biodiversity	Energy, Climate and Air	Freshwater and Oceans	Human well-being	Others
Agriculture, Food, Land and Biodiversity	30	4	4	5	6
Energy, Climate and Air	4	43	5	4	13
Freshwater and Oceans	4	5	17	0	3
Human well-being	5	4	0	16	4
Others	6	13	3	4	84

Climate CoLab

Cluster	Agriculture, Food, Land and Biodiversity	Energy, Climate and Air	Freshwater and Oceans	Human well-being	Others
Agriculture, Food, Land and Biodiversity	18	6	5	9	12
Energy, Climate and Air	6	12	2	7	6
Freshwater and Oceans	5	2	5	2	4
Human well-being	9	7	2	14	9
Others	12	6	4	9	23

Numbers indicate the count of seeds/proposals with at least one intervention from each of the intersecting cluster groups

a tendency to pair energy, climate and air with the "other" cluster, while in the Climate CoLab proposals, this pairing is one of the least common. The Climate CoLab proposals are far more likely to show pairings between various clusters and human well-being due to the strong representation of poverty alleviation across the Climate CoLab proposals. The key conclusion from this figure is that, when looking at real-world examples, it is possible for interventions to work across clusters. It is therefore also possible to give specific example of how to achieve the synergies described in Chapter 22.

Agriculture, food, land and biodiversity

Seeds and Climate CoLab proposals within the cluster for agriculture, food, land and biodiversity were most related to food access, protection of terrestrial ecosystems, and minimizing land damage **(Figure 23.11)**. No solutions targeted land ownership, and only two addressed nutrition management.

Some key trends emerging from this cluster are the decentralization and localization of food production (e.g. community-supported agriculture, urban farming innovations) to improve food access, minimize land damage and potentially improve yields. These types of solution could potentially address the yield-improvement trade-offs that were identified by Chapter 22, for example against addressing climate change and water scarcity.

Energy, climate and air

Seeds and proposals that fit within the energy, climate and air cluster were most related to low- or zero-emission technologies, behavioural change in the use of transport and household energy, energy access, and improved energy efficiency **(Figure 23.12)**. Bioenergy, negative-emissions technologies, and air-pollution control were addressed very sparsely. One of the Climate CoLab proposals "Adapting the indigenous approach to climate change adaptation and mitigation" makes clear the importance of not relying only on technological fixes, but recognising the relevance of local innovations that draw on a variety of knowledge sources.

Freshwater and oceans

The clusters for freshwater and oceans, combined for the analysis, were among the least-addressed ones, especially in Climate CoLab proposals **(Figure 23.13)**. Seeds within this combined cluster focused most on WASH (water, sanitation and hygiene) while no seeds or proposals addressed desalination or ocean regulation.

Figure 23.11: Total number of workshop seeds and Climate CoLab proposals addressing each intervention in the agriculture, food, land and biodiversity cluster (seeds and proposals are double counted when they meet multiple measures)

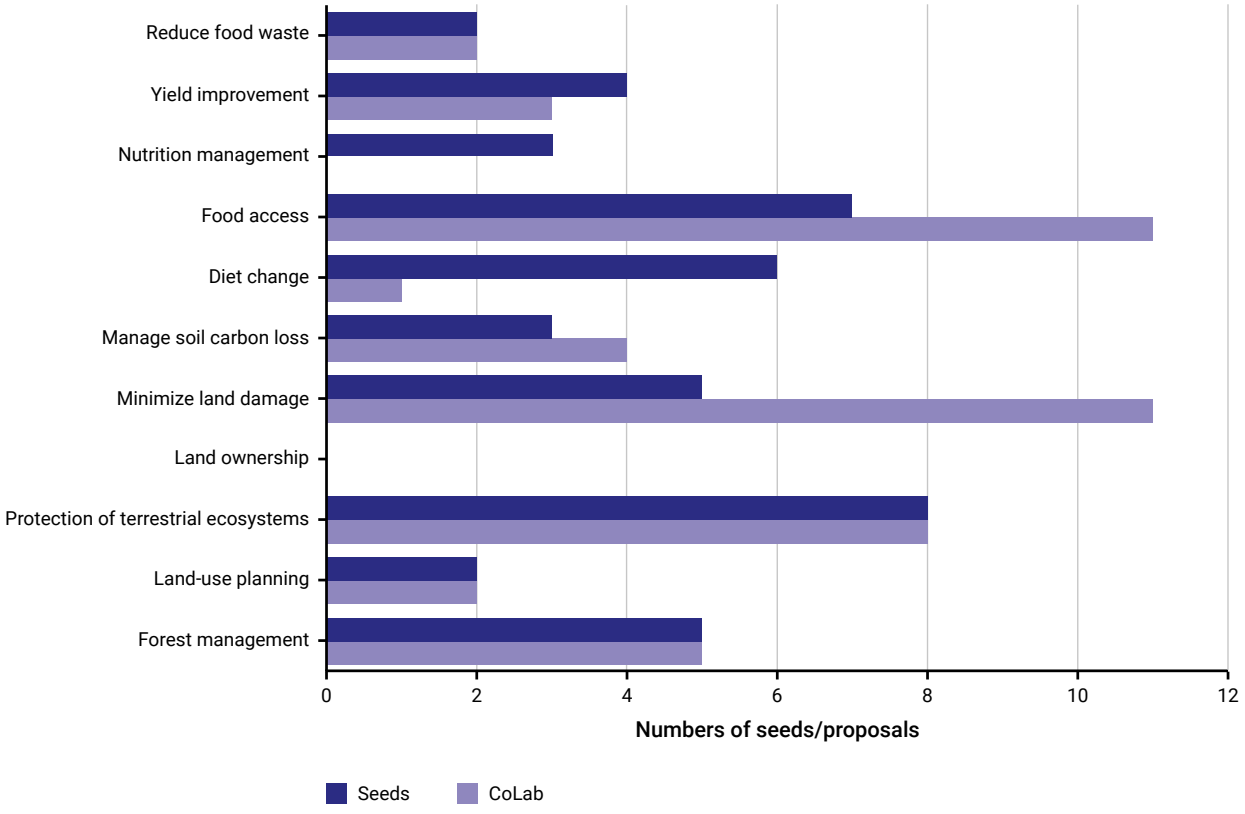


Figure 23.12: Total number of workshop seeds and Climate CoLab proposals addressing each intervention in the energy, climate and air cluster (seeds and proposals are double counted when they meet multiple measures)

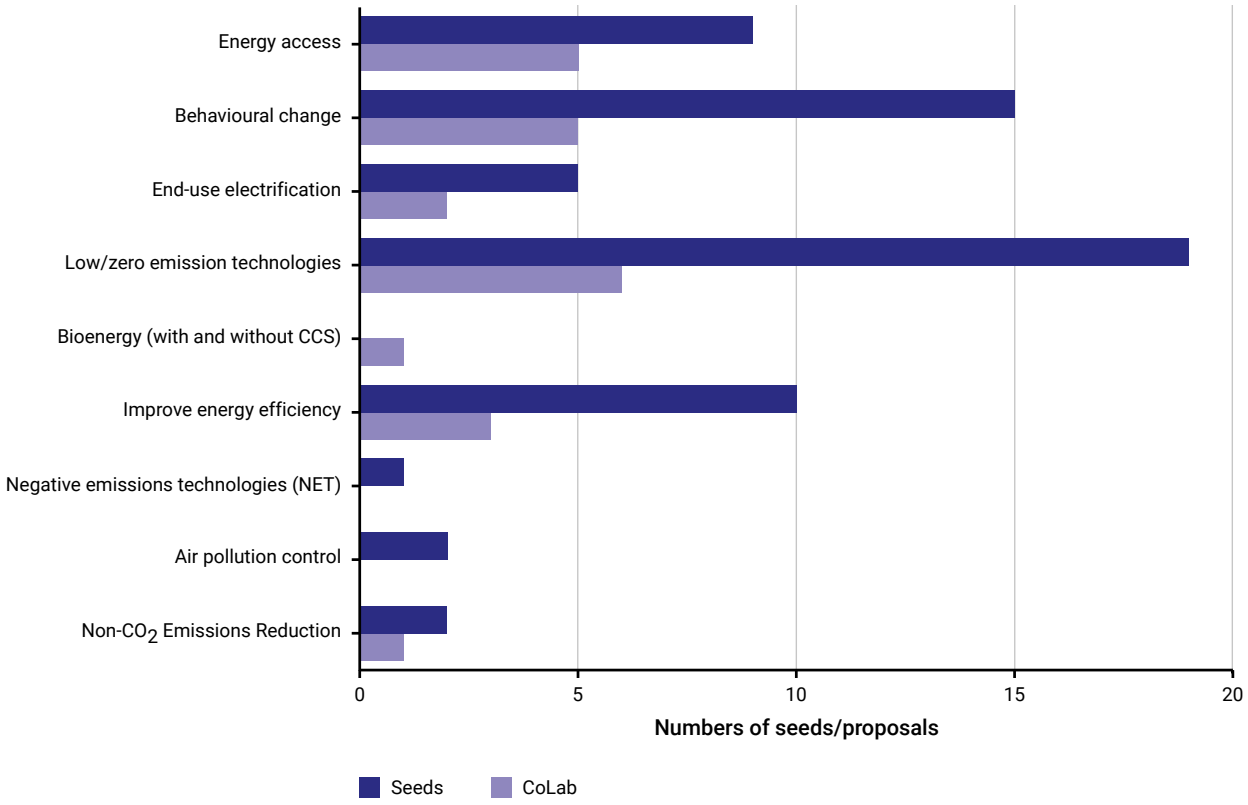
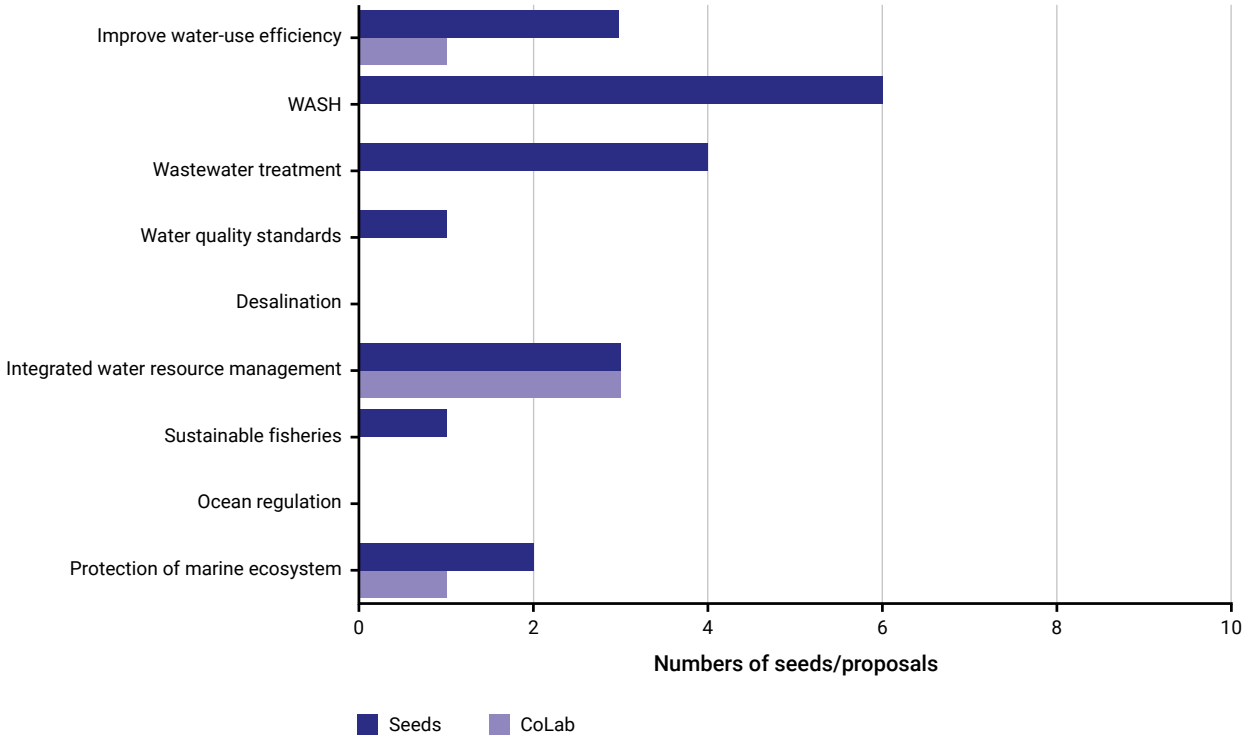


Figure 23.13: Total number of workshop seeds and Climate CoLab proposals addressing each intervention in the combined clusters for freshwater and oceans (seeds and proposals are double counted when they meet multiple measures)



Human well-being

Solutions related to human well-being focused predominantly on the alleviation of poverty while child and maternal health-care was addressed by only one Climate CoLab proposal **(Figure 23.14)**. This could highlight an important area for government interventions to specifically target these areas.

23.10 GEO Regional Assessment synthesis

The additional interventions highlighted by the GEO-6 Regional Assessments are presented below, followed by an outline of the main regional emphasis of different clusters of interventions, and a comparison with the prevalent top-down and bottom-up interventions.

23.10.1 Relevance of additional interventions for different regions

Nine additional interventions were highlighted in the Regional Assessments (see Section 23.11 for a more in-depth discussion). Two of these – effective governance, and awareness and skills building – were highlighted as important interventions across all six Regional Assessments. The Regional Assessments indicate the need to involve a diverse range of actors in seeking transformative solutions to achieve sustainable development, and all of the regional assessments emphasize the development of new collaborations between business, government and civil society. In addition to these commonalities, the assessments strongly reflected region-specific issues, which emphasizes the need for considering bottom-up initiatives. In North America, the identified governance and capacity-building needs focused on integrated forward-looking approaches that leveraged new technologies and citizen science in monitoring and reporting that would ultimately internalize environmental costs in the economy. Africa and Latin America and the Caribbean emphasized effective implementation and regulation to prevent further habitat loss and land degradation, focusing strongly on policies that strengthen equitable landownership and sustainable use of natural resources. Europe, and Asia and the Pacific strongly emphasized regional policy integration and cooperation, although the outlook for Europe focused its policy coordination around encouraging sustainable lifestyles, while Asia and the Pacific emphasized coordination as an adaptation response in disaster risk reduction. In West Asia, the dominant governance issue was peace and security. Only three assessments (Africa, Europe, and Latin America and the Caribbean) emphasized the need for global governance in addressing tele-coupling aspects that transfer the impacts of production and consumption to other regions. This limited consideration of interregional impacts, particularly from major regions of consumption such as North America and parts of Asia and the Pacific, is concerning and should be included as an explicit criterion in future Regional Assessments.

Monitoring and reporting, plastic and consumer waste reduction, and ecosystem restoration were also prevalent regional interventions that were not originally emphasized in the review of the scenario literature. Monitoring and reporting was emphasized by all regions except Europe, and the focus was on the use of new technologies and citizen science to monitor future trends and report on sustainable development. Plastic and consumer waste reduction was emphasized by most regions – except Africa, and Latin America and the Caribbean – and focused primarily on solutions against landfill being used for solid waste management. Ecosystem restoration was emphasized by Europe, North America and West Asia, but the focus differed in each region. In North America, restoration was considered important for improved water-quality management, while in West Asia restoration was strongly focused on restoring coastal marine ecosystems as a strategy to reduce disaster risk. In Europe, restoration was an integrative pathway to realizing multiple goals for biodiversity conservation, the rewilding of abandoned farmlands, a reduction of nitrogen and GHG emissions, and the mental and physical health benefits of restoring blue-green infrastructure.

Circular economies and smart cities for sustainability were highlighted as interventions by only some of the Regional Assessments **(Figure 23.15)** Nevertheless, at least two regions identified these as priority interventions, and there are indications from the bottom-up initiatives that these interventions represent emerging opportunities that can be leveraged as integrated and synergistic approaches to achieve sustainable futures.

Figure 23.14: Total number of workshop seeds and Climate CoLab proposals addressing each intervention in the human well-being cluster (seeds and proposals are double counted when they meet multiple measures)

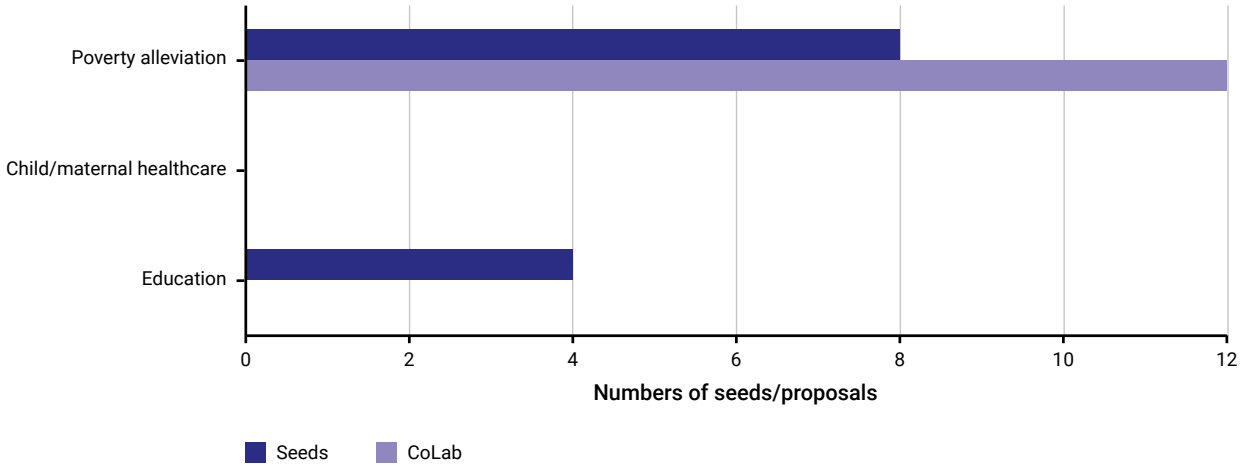


Figure 23.15: The interventions highlighted by the outlook chapters of the GEO Regional Assessments

Cluster	Measure Category	North America	Latin America and the Caribbean	Africa	Europe	Asia Pacific	West Asia
Energy, air and climate	Energy access			■			
	Behavioural change (transport and households)	■		■	■	■	
	End-use electrification						
	Low/zero emission technologies (non-biomass)	■	■	■	■	■	■
	Bioenergy (with and without CCS)	■	■		■		
	Improve energy efficiency	■			■		■
	Negative emission technologies				■		
	Air pollution control			■	■		
	Non-CO_2 emission reduction				■		
Agriculture, food, land and biodiversity	Reduce food waste	■			■		■
	Yield improvement	■		■	■		
	Nutrition management						
	Food access			■			
	Diet change						
	Manage soil carbon loss	■		■			
	Minimize land damage	■	■	■			
	Land ownership			■			
	Protection of terrestrial ecosystems	■	■	■	■		■
	Land-use planning		■	■	■		
	Forest management		■	■	■		
	Improve water-use efficiency	■		■		■	
Freshwater and Oceans	Blue carbon						
	WASH			■		■	■
	Wastewater treatment	■					
	Water quality standards	■					■
	Desalination						
	Integrated water resource management	■		■			■
	Sustainable fisheries			■			■
	Ocean regulation					■	
	Protection of marine ecosystems			■		■	
Human well-being	Poverty alleviation						
	Child/maternal health care					■	
	Education		■				
Other regional and bottom-up interventions	Effective governance	■	■	■	■	■	■
	Awareness and skills building	■	■	■	■	■	■
	Monitoring and reporting	■	■	■		■	■
	Plastics and consumer waste reduction	■			■	■	■
	Ecosystem restoration	■			■		■
	Smart cities for sustainability	■				■	
	Circular economy				■	■	■
	Sharing economy						
	Gender equality						

Blue indicates that the intervention was highlighted by the associated regional assessment for moving towards a more sustainable development trajectory; white indicates absence of the intervention. The interventions are clustered similarly to the grouping used in Chapter 22. Interventions that were not on the predefined list from the scenario literature review (those labelled "Other regional and bottom-up interventions") were added to derive an updated list of interventions (see Section 23.8).

23.10.2 Regional emphasis of different clusters of interventions

The most frequently occurring interventions across regions were low/zero-emission technologies, the protection of terrestrial biodiversity, effective governance, skills and awareness building, and monitoring and reporting. The Regional Assessments highlighted roughly similar proportions of interventions in the energy, climate and air cluster and in the agriculture, food, land and biodiversity cluster, with interventions in the combined cluster for freshwater and oceans showing only slightly less prevalence **(Figure 23.16)**. There was a marked absence of interventions that directly addressed the human well-being cluster (unlike the Climate CoLab proposals in which this cluster was emphasized heavily) Below the emphasis the regions place on the interventions within the clusters identified in Chapter 22 is discussed.

Energy, climate and air

A positive finding, also emphasized in Chapter 22, is that renewable energies are on the agendas of all regions. All six assessments – no matter whether primarily comprising developed or developing economies – emphasize renewable energies in their key interventions. In Africa, this is not only viewed as a way of improving air quality and GHG emissions, but also as a means of improving access to basic services by providing off-grid development in rural areas. In West Asia, renewable energies are viewed as a fundamental consideration for food and water security. Even though the GHG emissions in Latin America and the Caribbean are currently the lowest globally, the region places strong emphasis on renewable energies as a means of curbing current trends, which are expected to increase dramatically in the scenarios in which there is no investment in low-carbon futures.

Although renewable energies are on the agendas of all regions, there are clear gaps in interventions dealing with emissions reductions, with Europe being the only region to emphasize the full range of energy, climate and air interventions. This lack of direct action for climate mitigation is concerning. In addressing climate-change adaptation there is a definite regional difference: both Africa and North America emphasize food and water security; Asia and the Pacific, and West Asia emphasize disaster-risk reduction; Europe emphasizes air quality and health; and Latin America and the Caribbean focuses on ecosystem-based resilience and the need systematically to consider alternative sustainability framings that can be found in indigenous and local knowledge.

Agriculture, food, land and biodiversity

This cluster of interventions reflects the management of the land system, which has conventionally been dominated by ecological and biophysical perspectives. While protection of terrestrial ecosystems still dominates the interventions in this cluster, there are indications that conventional approaches are broadening in scope to include more integrated social-ecological initiatives, such as reduced food waste, yield improvement, agro-biodiversity, and forest and land management **(Figure 23.16)**. In Africa and Latin America and the Caribbean, this shift from a protection approach towards more sustainable land management has been reflected in the concept of ecological infrastructure and the complementary benefits it has for built infrastructure. In all regions, the lack of nutrition management and diet change, however, are notable gaps in the interventions highlighted by the Regional Assessments, indicating that the more behavioural aspects of the social-ecological spectrum have not yet been fully entrenched into this cluster in the regions. Similar gaps in socioeconomic interventions are prevalent in the human well-being cluster.

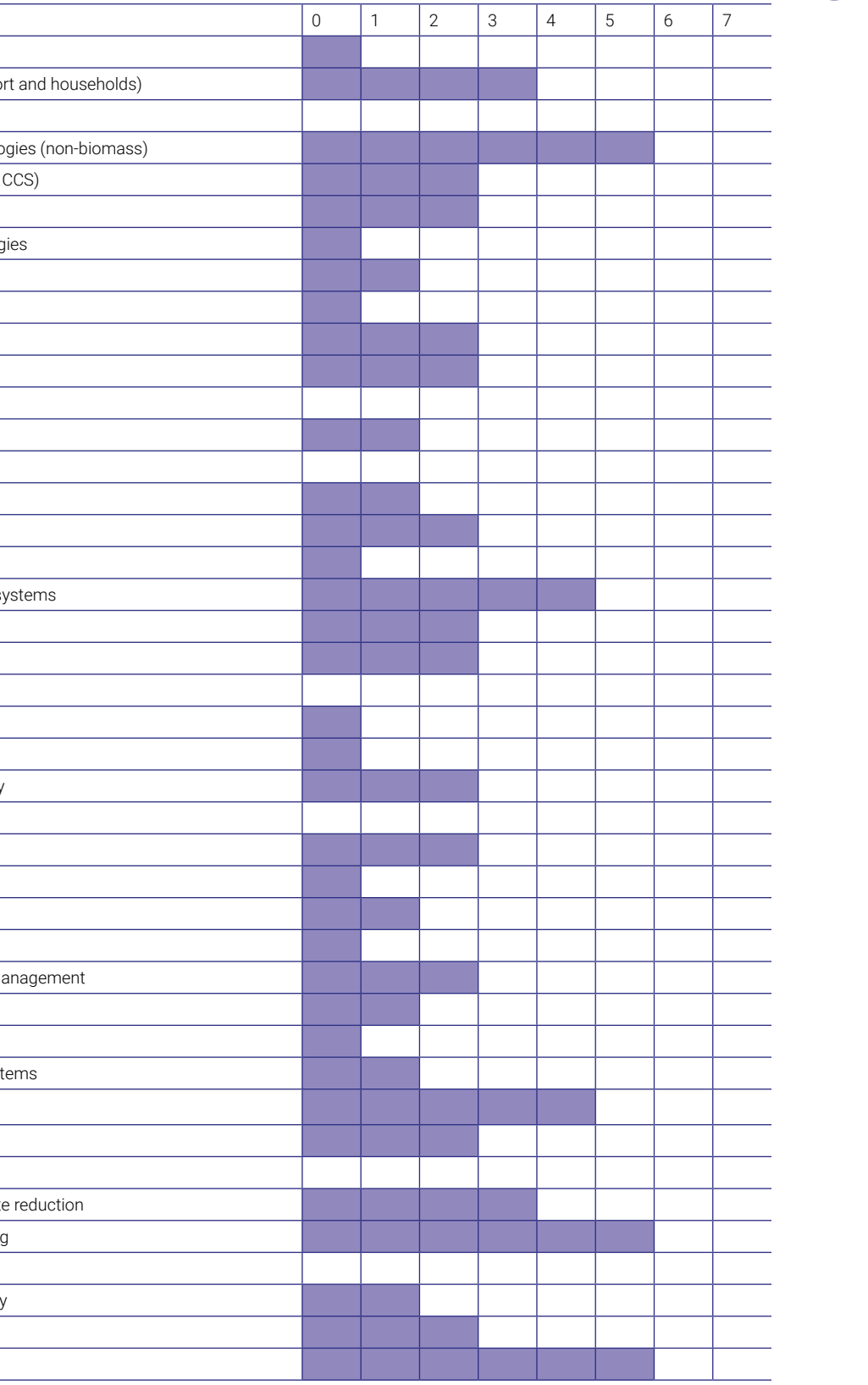
The interventions in this cluster also reflected region-specific environmental issues. Africa, and Latin America and the Caribbean had a very strong emphasis on protection of terrestrial ecosystems and sustainable land management, reflecting the need to address the enormous pressures these regions face around large-scale land conversion for agriculture. The Africa region, in its focus for leapfrogging to more sustainable development, also highlighted the potential for investment in agricultural intensification to increase efficiencies and improve agricultural yield simultaneously, and thereby minimize further habitat loss. Europe and North America placed strong emphasis on yield improvement and reduced food waste, with Europe also focusing attention on land abandonment and rewilding. Food access was another social intervention that was highlighted in this cluster, and this pertained to providing improved opportunities to smallholder farmers in Africa and West Asia.

Freshwater and oceans

Like the workshop seeds and Climate CoLab proposals, the Regional Assessments emphasized proportionally fewer interventions in the freshwater and oceans cluster compared with the previous two clusters in this section. The outlooks for Europe, and Latin America and the Caribbean were particularly scant on emphasizing interventions in this cluster. Both regions show signs of improvement in their key freshwater challenges (improved water quality in Europe; improved water supply and sanitation in Latin America and the Caribbean), so there may be more important regional challenges, such as production and consumption changes in Europe, and sustainable land management in Latin America and the Caribbean.

The most frequently emphasized freshwater interventions were integrated water resource management, improved water use efficiency, and water and sanitation. The first two of these are often bundled together, with the predominant narrative being around integrated water resource management to address water scarcity and water allocation issues. This was emphasized by Africa, Asia and the Pacific, and North America (the latter after recent droughts and under climate change projections). Interestingly, West Asia did not emphasize water scarcity in itself, but rather the investment costs of groundwater abstraction and desalination for continued water supply and sanitation of rapidly expanding cities. This indicates that at least one region is explicitly emphasizing diversification of water sources as a feasible response to water supply challenges. Water quality issues – both in terms of safe wastewater treatment and water supply quality – were addressed separately from integrated water resource management. Water quality interventions were emphasized in the Outlooks presented for North America and West Asia, where both regions highlighted issues with wastewater treatment as well as chemical contaminants.

Figure 23.16: Number of regions emphasizing interventions within the clusters identified in Chapter 22



Clusters identified in Chapter 22 (0 = none, 6 = all regions)

The regional Outlooks for Africa and Asia and the Pacific were the only ones that highlighted interventions for the oceans. For Africa, this was mainly around protecting marine ecosystems for sustainable fisheries. In Asia and the Pacific, protecting marine ecosystems was viewed as a strategy both for sustainable fisheries management and disaster risk reduction, particularly in relation to protection and restoration of mangroves.

Human well-being

There was a distinct lack of emphasis placed on the interventions in the human well-being cluster. Only one regional outlook (for Latin America and the Caribbean) identified one intervention (education) as a key intervention for transforming to a sustainable future. The more socially oriented interventions in other clusters were either poorly emphasized (e.g. energy access, food access, smart cities for sustainability), or not highlighted at all (e.g. nutrition management, diet change, poverty alleviation, sharing economy, gender equity and equality). This is not to say that human well-being interventions are ignored throughout the Regional Assessments or even in the chapter presenting the outlook. Indeed, in many cases, the synergies with human well-being SDGs are discussed, and in detail in some cases (e.g. Africa, and Latin America and the Caribbean). However, these are not emphasized as interventions in and of themselves. Instead, the Regional Assessments regarded interventions in this cluster as the fortunate spin-offs of managing the previous three clusters, rather than explicitly planning for synergistic target achievement. Future Regional Assessments could strive for more integrative strategies through explicitly addressing and planning for this cluster of interventions.

23.11 Regional outlook interventions and bottom-up initiatives

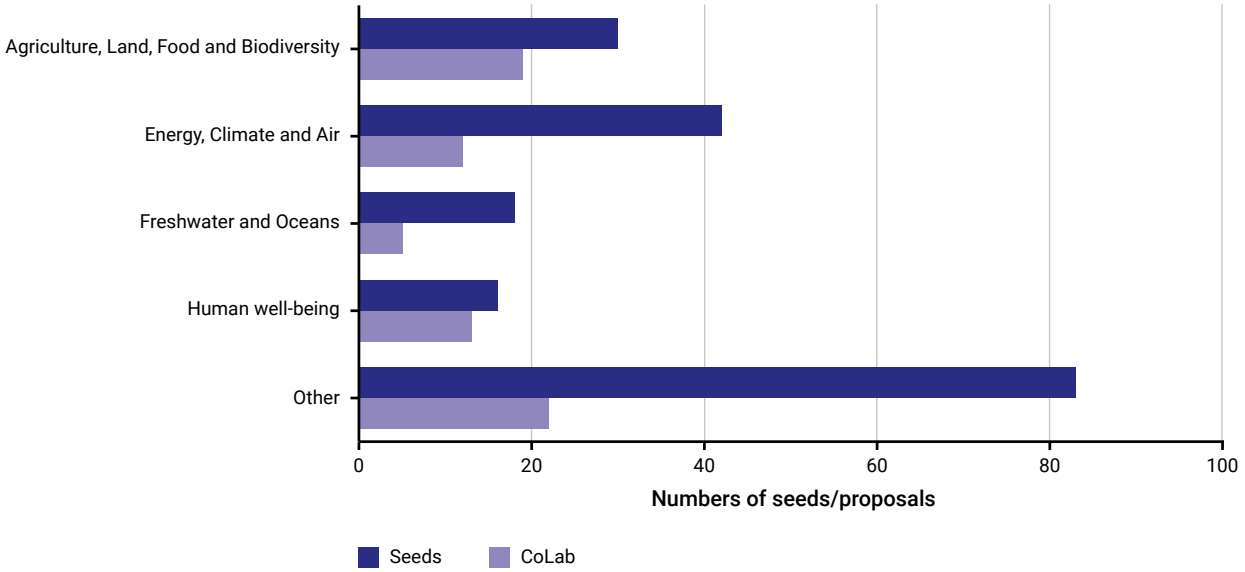
23.11.1 Additional categories of intervention

A large portion of solutions did not fit neatly into any of the categories of measures in Chapter 22 in the process of collecting and assessing the seeds and proposals, and reviewing the emphasized regional interventions (see "other" in **Figures 23.15** and **23.16**).

As a result, nine new categories were developed and coded as part of the analysis:

- **Monitoring and reporting**: Innovations to improve the monitoring and reporting of environmental conditions, including citizen science initiatives.
- **Circular economy:** Innovations that involve the increased efficiency of resource use, specifically through new business models that better engage with the issue of waste products of other production processes (See Ghisellini, Cialani and Ulgiati 2016).
- **Sharing economy**: Innovations related to the peer-to-peer sharing of goods and services, primarily through information and communications technology (ICT) platforms (See Hamari, Sköklint and Ukkonen 2016).
- **Plastic and solid waste reduction:** Innovations that help to reduce plastic and solid waste.
- **Awareness and skills building:** Education related to sustainability and environmental issues to improve public awareness and build relevant skills.
- **Gender equality:** Solutions that promote the fair treatment of all genders, including female empowerment and considerations of gender equity.
- **Smart cities for sustainability:** Smart cities use modern digital technologies, such as apps for mobile phones, to engage and connect citizens in addressing their key sustainability challenges, such as city transportation, consumption patterns, energy, nutrition, water and waste.
- **Ecosystem restoration:** The process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed. Although this category would fit well under the agriculture, food, land and biodiversity cluster, it is considered as a separate category here due to the emphasis on this intervention in the reports. In future assessments, it could be adapted to refer to nature-based solutions, encapsulating those relevant innovations that draw on indigenous knowledge and ecological infrastructure.

Figure 23.17: Seeds and proposals by cluster



- **Effective governance**: Solutions to improve regional cooperation, and harmonization across scales, including to improve the management of interlinkages and tele-coupling between systems to reduce interregional inequalities.

Sixty out of the 157 workshop seeds, and seven out of the 34 Climate CoLab proposals, were coded against interventions exclusively from this new set of categories grouped as "other" **(Figure 23.18)**. For seeds and proposals with measures that were coded across both "other" and at least one of the four clusters, some preliminary patterns emerged, although the sample sizes were small. For seeds, the most common cluster to be paired with "other" measures was energy, climate and air, with seeds linking this cluster to monitoring and reporting, smart cities, and awareness and skills building. Gender equality appeared in only two seeds and neither of these was coded against any of the four main clusters. In contrast, in the Climate CoLab proposals, gender equality, and awareness and skills building emerged as the strongest intervention categories and appeared in various proposals paired with all of the four main clusters. These proposals ranged in their suggestions from a mentoring network for women to female economic empowerment through activities like beekeeping. Agriculture, food, land and biodiversity emerged as the strongest cluster paired with various "other" interventions. While monitoring and reporting was a strongly represented measure in seeds, it was far less prevalent in Climate CoLab proposals.

Two interventions are highlighted in the platforms of bottom-up initiatives that are not included in the global assessment: sharing economies and circular economies. These show

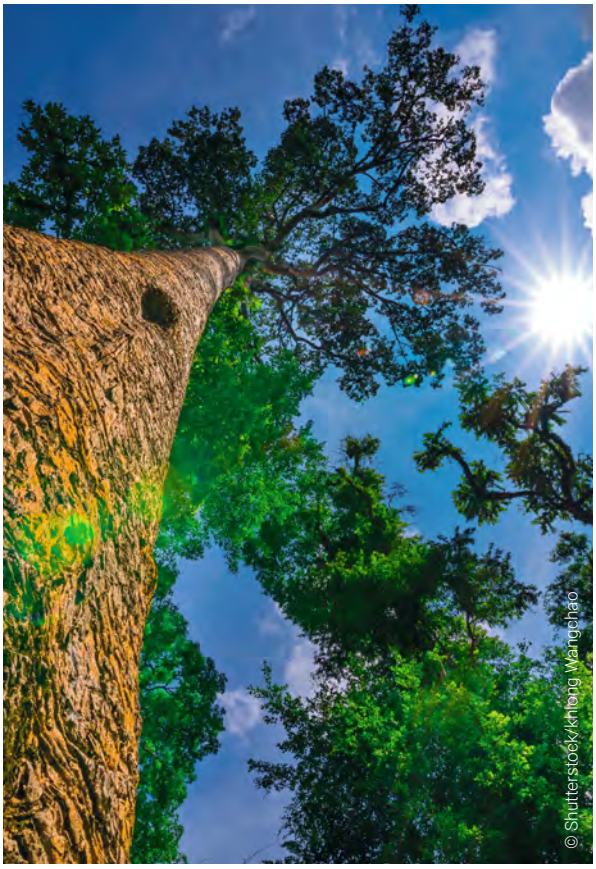


Figure 23.18: Count of the number of pairings of "other" measures with at least one intervention from a main cluster group

Workshop Seeds

"Other" category	Agriculture, Food, Land and Biodiversity	Energy, Climate and Air	Freshwater and Oceans	Human Well-being
Monitoring and reporting	2	5	0	1
Circular economy	2	1	2	2
Sharing economy	0	0	0	0
Plastics and consumer waste reduction	2	1	0	2
Awareness and skills building	1	3	0	0
Gender equality	0	0	0	0
Smart cities for sustainability	0	4	0	0
Ecosystem restoration	0	0	1	0
Effective governance	0	0	0	0

Climate CoLab

"Other" category	Agriculture, Food, Land and Biodiversity	Energy, Climate and Air	Freshwater and Oceans	Human Well-being
Monitoring and reporting	0	0	0	1
Circular economy	3	0	1	2
Sharing economy	2	1	0	1
Plastics and consumer waste reduction	2	1	0	0
Awareness and skills building	5	5	2	4
Gender equality	6	3	3	2
Smart cities for sustainability	0	0	0	0
Ecosystem restoration	1	0	0	1
Effective governance	0	1	0	0

innovations that would boost the energy cluster, and also address production and consumption challenges in the agriculture, food, land and biodiversity cluster **(see Box 23.6)**.

23.11.2 Implications for future assessments

The global review of the scenario provided a useful overview for synthesizing the range of potential interventions available for moving to a more sustainable future. Furthermore, by having concrete examples, it was possible to analyse the likely synergies and trade-offs between these interventions. However, the nine additional interventions that were uncovered in the bottom-up analysis should be considered in future global Outlooks **(Figure 23.18)**. Smart cities, for example, were emphasized in the regional Outlooks as a means of achieving integrated responses to sustainability that capture many interventions towards transformative change. Exploring these urban opportunities, and the role they have in shifting urban-rural dynamics, should be a strong focus in global assessments given current population and urbanization trends. The bottom-up initiatives highlight sharing economies and circular economies as fast-evolving, and region-specific emerging interventions. Future global assessments should aim to factor the impact of such interventions into their outlook. Although the important role of indigenous and local knowledge in sustainability innovations not added in as a separate category, this has been captured as an important aspect in similar participatory processes undertaken by IPBES (See Lundquist 2017; IPBES 2018e) and could be highlighted in the next iteration of assessments.

Regional emphasis for the same intervention, or clusters of interventions, can differ enormously across and within regions. Collecting, piloting and scaling a diverse range of bottom-up initiatives that are relevant to the local context can therefore be extremely useful in providing tangible examples to policymakers of otherwise generic pathways. Effective governance, and awareness and skills building were two interventions that all Regional Assessments emphasized. By comparing the interventions identified in the chapters presenting the Outlooks from the Regional Assessments with interventions identified from the review of the scenario literature, we identified several gaps, which should be noted and explicitly considered in future Regional Assessments. The most notable gaps were in the human well-being cluster, and in the inclusion of more social and behavioural interventions in the other clusters (e.g. nutrition management, diet change, energy access).

The review of the global scenario literature showed clearly that some interventions towards sustainable development could achieve synergies across multiple targets, while others may lead to trade-offs with specific targets. **Table 22.1** provides a template for understanding which interventions trade off against each other or provide co-benefits. This systematic consideration of synergies and trade-offs between interventions would ensure an integrated approach that links top-down and bottom-up visioning.

23.12 Enabling conditions for transformations

The literature argues that transformations for sustainability require innovation – both technological and institutional (Olsson *et al.* 2017). Chapter 24 elaborates more fully on the relationship between policy and enabling transformative change towards achieving specific future goals. This chapter concludes with a discussion of what types of conditions are

Box 23.6: Case study: food systems

GEO-6 identifies the food system as a key cross-cutting issue due to its wide-ranging environmental impacts (water, land and GHG emissions) (see Chapters 4, 8 and 17). In the stakeholder engagement and crowdsourcing initiatives throughout the GEO-6 process, 27 out of the 156 workshop-collected seeds related directly to food, and 11 out of the 34 Climate CoLab finalists' proposals did as well. There was a willingness demonstrated by participants to embrace a more sustainable food system, with a large diversity of proposals including dietary change (e.g. eating less meat), reduction of waste in the food distribution system, and alternative production systems. Some workshop seed proposals did not address environmental impacts explicitly, such as those relating to food waste; however, given that an estimated one-third of food produced globally is wasted (see Chapter 8), reducing this would make more effective use of the natural resources consumed by agricultural production.

Several of the workshop seed proposals related to dietary change, specifically advocating increased uptake of – and support for – vegetarian and vegan diets. Such diets are widely understood to demand less land, water and energy than meat-based diets (Pimentel and Pimentel 2003), although regionally appropriate livestock rearing on pasture can be sustainable (Eisler *et al.* 2014). Others related to alternative farming methods (e.g. urban agriculture, rooftop farms, agroforestry) that could potentially have a positive impact on food security while reducing dependence on land and/or water resources. The Climate CoLab proposals contained more detail than the seed initiatives collected during the face-to-face stakeholder workshops. While the dominant focus of these proposals was obviously climate change, about one-third were related to the food system. Proposed solutions ranged from very broad-scope, global interventions such as a sustainability network involving "tens of thousands of food forests" through to more targeted interventions such as improving the moisture-retention capacity of agricultural soils in drought-affected parts of Africa. Notwithstanding the challenge of demonstrating effectiveness, the bottom-up scenarios show a clear willingness to embrace changes in the food system, suggesting a degree of public awareness of the necessary changes identified in the modelled pathways in Chapter 22.

Some of the proposed interventions, both from the seed workshops and from the Climate CoLab platform, could represent game-changers that – subject to further, rigorous examination – have the potential to fundamentally alter the way to develop model-based food-production scenarios in the future. The modelled links between population, meat consumption, average agricultural yields and resultant land use could be substantially reimagined in light of, for instance, widespread reuse of food waste for nutrient recovery (Cordell *et al.* 2011), combined with regenerative, ecological and multifunctional agriculture systems that have the potential to both increase and diversify yields (Horlings and Marsden 2011). In addition, radical models of optimized hypothetical diets have also been presented in the literature (Schramski *et al.* 2011; Ward *et al.* 2014), which could play a role in altering the conventional views in scenarios, of a rigid relationship between humans and land use.

required to enable bottom-up initiatives to scale and achieve potentially transformative change. There are many existing and ongoing initiatives that aim to achieve the SDGs and other global multilateral environmental agreements. Although these initiatives may be the potential building blocks of a more desirable future for people and the planet, higher-level enabling governance conditions will be crucial to their scalability (Moore, Riddell and Vocisano 2015).

A large amount of literature exists regarding sustainability transformations that provides a useful framework to understand the governance conditions needed to transform unsustainable systems and scale the innovations mentioned by workshop seeds and Climate CoLab proposals. Sustainability transformations are often broken down into multiple phases, with temporal periods related to a problematic status quo, a preparation phase in which innovations begin to develop, a navigation/acceleration phase in which innovations grow and become part of the new system, and an institutionalization phase in which a more desirable system is made sustainable in the long term (Olsson *et al.* 2006; Moore *et al.* 2014; Pereira *et al.* 2018a). For transformations to occur successfully, each of these phases requires governance conditions that are strongly enabling. These enabling conditions can best be broken into supporting conditions for the scaling innovations appropriately and disrupting conditions for the weakening of existing, problematic structures.

To connect the theory to the bottom-up results, **Table 23.3** introduces the enabling and disruptive conditions for the transformations identified by the existing literature and provides examples that connect back to the workshop seeds and Climate CoLab proposals.

23.13 Key messages

The analysis of potential bottom-up and regional solutions for achieving a healthy planet, healthy people highlighted the need to do the following:

1. Integrate top-down and bottom-up approaches to developing scenarios.
2. Consider the full range of actors involved in achieving sustainability.
3. Recognize the need for distributive justice when setting expectations about where action should take place.

Table 23.3: Summary of enabling and disruptive conditions for the appropriate scaling up, out and deep of potentially transformative innovations

ENABLING CONDITIONS	
Establishing and supporting markets for innovations *Governance for transformations should involve establishing and supporting new markets for innovations. This consists of policies like regulations, tax exemptions, deployment subsidies and labelling*	Some seeds and proposals mentioned creating and expanding markets such as an ethical fashion industry, and many others looked at innovations related to new and growing markets within the circular and sharing economies. These changes may require market-supporting policies like the labelling of fashion projects that meet certain standards, and subsidies that make niche innovations (e.g. in reusing waste) more affordable for consumers. More generally, policymakers and stakeholders should constantly explore how more sustainable markets related to identified innovations can be supported until they become the norm.
Supporting innovation experimentation and learning *Learning and experimentation support includes support for research and development, deployment and demonstration, policies that stimulate entrepreneurship, incubators, low-interest loans, venture capital and supportive regulatory conditions*	Not many seeds and proposals specifically addressed experimentation and learning support. The most relevant seed was an innovation lab focused on sustainable innovations at the local level. However, given that the seeds and proposals are new innovations predominantly in their prototype or early stages of development, support for innovation experimentation and learning is needed to ensure continued growth. Governance related to all seeds and proposals should strive for continuing improvements to make the solutions viable in the long term.
Financial resource mobilization *Financial resource support is the mobilization of financial capital through funding mechanisms, low-interest loans and venture capital*	A large number of seeds and Climate CoLab proposals identified a need for greater financial mobilization including the mobilization of domestic funds; the Inga Foundation's proposal seeks international funding to help fund its projects; Govardhan Ecovillage proposes a Green Innovations Fund; and "Framework for Community-based Sustainable Development" mentions a need for developed countries to transfer financial resources (and technological expertise) to less developed countries. Related to supporting markets, supporting experimentation and learning, and financial resource mobilization is the emphasis on subsidies and incentives to support new innovations. Workshop pathways, particularly those developed in the Singapore workshop, emphasized the need for subsidies to promote renewable energy development, green urban infrastructure, and sustainable farming. Climate CoLab proposals went into further depth. The proposal "Climate protection by the elderly" called for incentives for the elderly to work, incentives for developing carbon sinks, and education subsidies for children involved in the programme. A proposal submitted by the Govardhan Ecovillage suggested subsidies for organic farmers. Another example, "Business plan for production and marketing of compost from urban solid wastes", suggests incentives and subsidies for individuals, cooperatives, businesses, etc.

Enabling/disruptive condition and description (Adapted from Kivimaa and Kern 2016)	Connection to the workshop seeds and Climate CoLab proposals
Human resource mobilization *Human resource support is the mobilization of human capital through education and labour policies*	Human resource mobilization was a salient theme within the seeds and proposals, particularly the role of educating and engaging people on environmental issues. There was a large number of awareness, knowledge, and skills development solutions, all of which help to mobilize people towards transformations. Seeds-based visions from all four workshops also listed public awareness as a key component of realizing the participants' imagined sustainable futures. Some unique and exciting examples of human resource mobilization include educating the youth to work on climate issues through the 'Youth Climate Leaders' and "Youth Informing Communities on Climate Change Adaptation through building homes" Climate CoLab proposals, and the many app-based solutions that make environmental engagement accessible. More broadly, for significant scaling up of solutions, labour policies will need to promote and reflect the same development priorities as the solutions. Considering that many seeds referred to the development of solar power, there will be a need for labour and training policies, for example, to help promote education and skills development to meet scaling up needs.
DISRUPTIVE CONDITIONS	
Control policies *Control policies are taxes, trade restrictions and regulations that can be instituted by government actors to make existing processes less profitable or more sustainable*	Seeds and proposals related to control policies included introducing limits on plastic, cutting red meat from diets, and bans and taxes on plastic packaging. Control policies like taxes that internalise social and environmental costs and restrictions appeared less often in the bottom-up initiatives than many other enabling conditions as they are related to dealing with existing structures rather than innovating for new solutions. It is important to acknowledge that for all seeds and proposals, transformations usually have winners and losers (Meadowcroft 2011; Geels 2014). As such, for every new innovation there are displacements that can be promoted through control policies (and should be explored), although such policies should consider their wider implications as they can have unintended consequences.
Rules reform *Rules reform consisting of radical policy reforms and changes in overarching rule structures*	A few seeds and proposals suggested entirely new rule structures to promote sustainability, such as embracing the concept of a well-being economy. These included lowering the age of decision makers (e.g. to vote) and policymakers, introducing new financial systems that incorporate the value of the environment, and expanding the circular economy with extended producer responsibility.
Reduction in existing regime support *The removal of supporting conditions that have allowed for the existing, problematic structures to be successful*	Solutions that tackled the conditions that make existing systems successful mostly focused on informing and engaging people on why the existing structures are problematic and how to do things differently. For example, many apps looked at teaching users how their lifestyle was environmentally unfriendly and how to improve, and programmes such as 'No Straw Tuesdays' aimed to challenge the excessive use of straws and plastics more broadly. This can be extended to include the removal of environmentally and socially perverse subsidies.
Changes in networks and key actors *The replacement of incumbent actors and the breaking of powerful actor-network structures in favour of new actors and networks more favourable to the desired transformations*	Several workshop pathways and Climate CoLab finalists referenced changing current actor relations, specifically through building collaborative environments and new, involved networks of stakeholders. Decentralized power and action in large networks was a key component of many seeds. One Climate CoLab proposal, 'C'SQUARE' reflected the trend found in workshop pathways and mentioned the need to empower and mobilize citizens in order to gather their opinions to improve urban areas. Its success was dependent on strong partners and collaborations. The 'Organic Monetary Fund' and "Framework for Community based Sustainable Development" Climate CoLab proposals focused on engaging stakeholders at all levels, including the national governments, international organizations, local communities and relevant experts.

Ongoing efforts to incorporate the impact of bottom-up climate action into existing climate scenarios illustrate how including bottom-up activities can do the following.

- Create a more accurate understanding of existing sustainability pathways and where there are gaps.
- Help national governments to support and account for bottom-up activities in their own agenda setting.
- Identify small-scale initiatives that could provide functions (e.g. capacity-building, piloting of innovative solutions) that may be difficult to quantify but can be critical to achieving the transition to a low-carbon society (Chan, Brandi and Bauer 2016). The concentration of Climate CoLab proposals in the global South suggests that these activities could, for instance, fill a key data gap in current records of sustainability innovations beyond the global North.

23.13.1 Methodological learnings

This lack of bottom-up futures in the context of sustainability poses major challenges. In terms of legitimacy, large-scale global or regional futures that do not represent the diversity of many different lived experiences, world views and discourses risks giving insufficient space for the concerns and needs of different societal actors. It is difficult to imagine transformative change if large-scale sustainability futures do not draw on

insights and perspectives from local and national levels, as well as incorporating diverse knowledge systems like those of indigenous people. Many of the seeds for better futures exist today in the margins of current systems, which often means that they operate locally, even if they are sometimes organized through trans-local networks (Bennett *et al.* 2016). This trend goes for seeds that may contribute to more desirable futures, such as practices, technologies and forms of governance that might have a global impact. It also holds for new threats and risks that might modify the challenges of the Anthropocene as they emerge, such as conflicts, natural resource crises, diseases and problematic technologies (Steffen *et al.* 2015). Furthermore, the lack of bottom-up contributions to global sustainability futures also has consequences for how these scenarios and visions are used. If global futures lack connections to on-the-ground realities, they may be deemed too theoretical and too generic to inform decision-making. If such futures are used, the top-down framing of future challenges at local levels can limit what gets considered and affect the legitimacy of who contributes to this framing of the future (Vervoort *et al.* 2014).

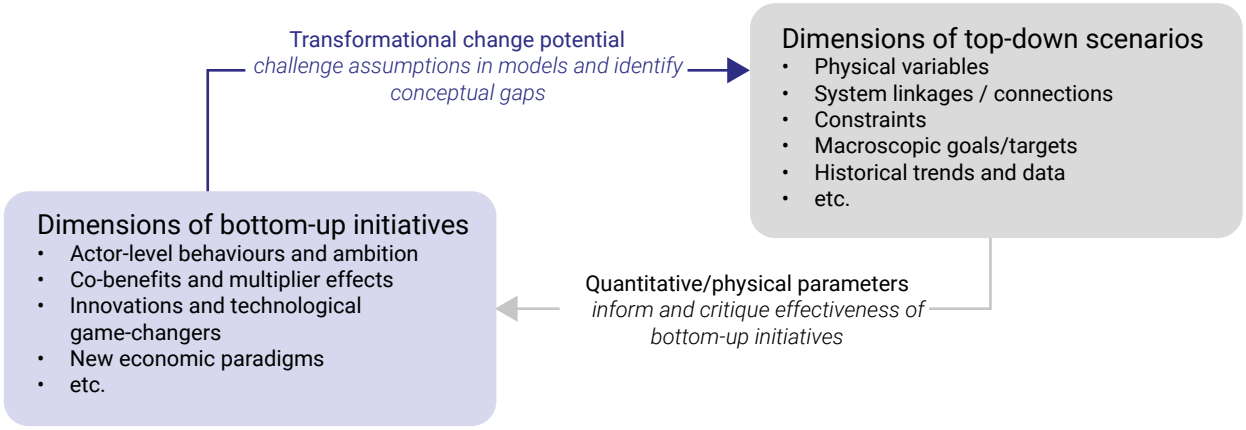
The top-down scenarios based on integrated assessment models, and the participant-based bottom-up initiatives both have strengths and weaknesses as tools to chart a course towards sustainability. If used well, both approaches have the potential to complement and mutually reinforce one another, as shown in **Figure 23.19**.

The seeds workshops and Climate CoLab proposals represent a small sample, but they show that some solutions are highly synergistic in terms of the SDGs addressed, extremely diverse in scope, and multidimensional in ways that make categorization by any single dimension challenging. The initiatives targeted all SDGs, but were most focused mainly on SDGs 2, 3, 11, 12 and 13. The domains addressed by the initiatives were diverse, and – beyond the expected focus on climate change by Climate CoLab proposals– both the seeds and the Climate CoLab proposals focused in a cross-sectoral manner on the food, energy, water, and waste sectors and their interconnections. Seeds and Climate CoLab proposals envisioned changing systems largely through new technologies, but they also envisioned change occurring through lifestyle shifts, enabled by improving environmental awareness through education, skills development and knowledge generation. Climate CoLab proposals differed slightly and looked at changes in production practices and proposed new organizations and businesses as well as proposing the development of awareness, knowledge and skills. Finally, in examining the Climate CoLab proposals, an overwhelming focus was put on solutions for the global South, particularly for countries in Africa and Asia.

At the same time as quantitative, top-down approaches can be used to inform and strengthen the physical basis for bottom-up initiatives, those bottom-up ideas can in turn challenge overly rigid or outdated assumptions in top-down models. Using bottom-up approaches, it can be possible to identify game-changing concepts that fundamentally restructure the way we view future scenarios. One tangible example is the development of small-scale, decentralized renewable energy systems. The rapid pace of technological development and the associated decrease in the cost of, among others, solar photovoltaics and battery storage, coupled with ICT, makes microgrids a new possibility for areas not yet served by conventional electricity from fossil fuels. This has already become a reality in Kenya since the establishment of M-KOPA, a mobile-enabled payment system for Solar Home Systems in 2013. These technologies – and the public demand to embrace them – mean that the types of energy transition characterizing the past (coal to oil, oil to gas, gas to large-scale renewables) may not necessarily characterize the leapfrog development of energy supplies in the future.

There are many similarities between the macro-level pathways in Chapter 22 and the bottom-up interventions in this chapter. Interventions discussed in both have significant co-benefits for several SDGs. There is a prominent focus on urban sustainability and on food waste and diet change in both analyses **(see Boxes 23.5 and 23.6)**. A crucial complementarity that becomes clear is that the macro-level pathways in the global models allow for an integrative analysis of many contextual drivers and interventions, while the bottom-up pathways provide information about the theories of change underlying the ways of scaling of high-potential practices to achieve the SDGs. The complementary insights provided by the bottom-up and the macro-level pathway analyses demonstrate that further integration of these approaches has much potential. For instance, global modelling results could be used

Figure 23.19: Conceptual framework for mutually beneficial feedbacks between top-down and bottom-up approaches to generating sustainable scenarios



to provide direct global contexts for stakeholders developing bottom-up pathways; and bottom-up pathways can provide directions for future model extensions.

The platforms pioneered in GEO-6 represent an opportunity – if adopted in future assessments – for the top-down scenario-development community to receive feedback on the public acceptance of the various interventions and their trade-offs adopted. To meet the requirement of an increased food supply, for example, pathways include the expansion of agricultural land for rain-fed agriculture (at the expense of biodiversity), or increased use of fertilizer and irrigation to improve yields on the land already in use (at the expense of water resources and pollution). Stakeholders could be consulted to gain insights into the relative acceptance of different options, as well as to identify blind spots in the modelling approach that may mean alternative, synergistic solutions are being overlooked. Similarly, gaps in actual interventions that could help to achieve SDG targets can also be revealed – as is the case with interventions specifically aimed at drivers like population growth that present an important challenge to sustainability, as identified in Chapter 22 and across the chapters of Part A.

Longer-term possibilities for integration could include quantitative aggregation of local scenarios and seed initiatives with direct links to model inputs and outputs; and model integration with online crowdsourcing of bottom-up pathway elements.

23.14 Key interventions and a critical need to recognize distributive justice given global inequities and inequality

The analysis of the Climate CoLab proposals, where an overwhelming focus was put on solutions for the global South, particularly countries in Africa and Asia, highlights existing inequities in the perceptions of where interventions are necessary for transformation, and of who needs to act. While our analysis was of a small subset of studies, if it is indicative of broader perceptions, the burden placed on the global South to transform and implement development initiatives or solutions exacerbates current power inequities in global governance structures (Nagendra 2018; Newell 2005; Parks and Roberts 2008; United Nations Research Institute for Social Development [UNRISD] 2016). This imbalance can obscure or ignore the role of the global North in current development trajectories (e.g. focusing only on poverty alleviation and not discussing wealth redistribution). While the GEO Regional Assessment for Europe did highlight trade-offs and tensions associated with tele-coupling, the limited emphasis on tele-couplings generally is of concern and requires concerted effort (tele-couplings highlight consumption patterns in one region driving environmental concerns related to production in another region) (Liu *et al.* 2013; Seaquist, Johansson and Nicholas 2014). Here, incorporating principles of distributive justice – normative principles designed to guide the allocation of the benefits and burdens of economic activity based on fair distribution (Lamont and Favor 2008) – can help to construct a development agenda based on principles of equity and equality. Such an equality-based and equity-focussed framework can help to account for the disparate developmental conditions of the global South and global North (Rosales 2008; Pelletier 2010; Nagendra *et al.* 2018). This process can provide more equitable options for where and how to implement the solutions with the most transformative potential to achieve sustainable development; for example, in reforming consumption and production patterns or in instituting market mechanisms such as caps in emission-trading schemes, carbon taxes and offsetting schemes. Addressing these global inequities is a means through which to achieve the global goal of equality.

Many of the solutions presented in this chapter do offer the opportunity for developing countries to leapfrog onto more sustainable and equitable development trajectories. The use of ICT plays a major role in driving change in the bottom-up pathways – a result of a stronger focus on theories of change and on *how* change processes are facilitated. There are already many good examples of how this is being leveraged for change in the global South (Karpouzoglou, Pereira and Doshi 2017; Ockwell *et al* 2018). The roles of different societal actors and diverse knowledge systems are made explicit in bottom-up pathways. There is an important role, for instance, for city-level government actors in many proposals. The proposals also include a role for global networks of, for instance, sustainable cities or energy cooperatives. Similarly, diverse higher-level enabling conditions like international agreements, again tied to specific actors, are discussed as part of the bottom-up pathways and their seed initiatives (see Byrne *et al.* 2018 for a discussion on the need for international agreements to enable niches for achieving global energy and climate ambitions).

Chapter 22 identifies trade-offs in the balance between yield improvements and a set of human and environmental goals that include preventing nutrient pollution, limiting climate change, improving child health, providing universal access to clean water and sanitation, and neutralizing land degradation. The present chapter has offered some potential solutions for minimizing such trade-offs and maximizing the synergies. There was a large emphasis on food systems being a critical intervention point for moving towards a healthier planet as well as healthier people. Many seeds and proposals addressed current challenges in the food system by referencing examples that are taking place right now –examples of urban agriculture, aquaculture, diet-change initiatives, and indigenous and local knowledge exchanges (see Annex 23-1).

Chapter 22 also identified a challenge in promoting economic development while reducing emissions. The many initiatives for sharing and circular economies seen in the bottom-up pathways help towards a transformative shift to a well-being economy that no longer presents trade-offs. These pathways offer grounded methods to address global trade-offs.

This analysis has highlighted the specific interventions that governments could facilitate in the shift towards a healthier planet with healthier people, and has highlighted how these interventions differ across different locations. It has also offered some specific examples of where and how change is starting to happen. These are further developed in Chapter 24.

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